Welding Engineer

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OCTOBER, 1959

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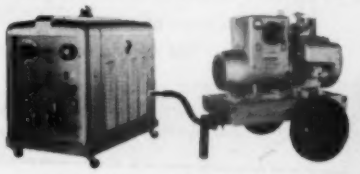

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VOL. 44 — No. 10

The magazine of joining and severing materials

Welding Engineer

This is welding: October, 1959

WELDING THE REACTIVE METALS

Welding the reactive metals 43

Nuclear-age metals in their pure forms were considered mere laboratory curiosities until their commercial application in recent years. Welding of the three best known, titanium, zirconium and tantalum, is discussed by authors **L. M. Gourd** and **F. W. Copleston** in this introduction, and detailed in the succeeding articles.

Argon will be more plentiful, cheaper 45

Since all welding of reactive metals necessitates inert-gas shielding, and argon being the most commonly used, *WE* conducted a survey of leading argon producers in order to report their feelings on the future of this particular gas.

Eliminating contamination is a prime consideration 46

A simple equation is at the heart of titanium welding: hot metal, plus air, moisture, dirt, etc., equals contamination. **T. M. Laurenson** details the various factors to be considered for proper shielding when Tig welding this reactive metal.

★ (For a reprint of this article, circle number 247.)

How to weld zirconium and its alloys 50

Like titanium, zirconium is highly reactive to oxygen and nitrogen, and since arc welding is recommended to retain this metal's highly desirable properties, author **L. E. Stark** lists the particular steps necessary for properly joining this nuclear-age metal.

★ (For a reprint of this article, circle number 248.)

Resistance spot-welding of tantalum studied 52

Although Tig welding is recommended for joining the reactive metals, studies are being conducted on the possible use of other welding processes. **J. J. Vagi** and **R. L. Koppenhofer** report on the experiments made at the Battelle Memorial Institute when resistance spot-welding tantalum.

★ (For a reprint of this article, circle number 249.)

Tig process produces strong, ductile tantalum welds 54

The last of the three reactive metals to be considered here is tantalum. Author **Alan Busto** discusses the various procedures and their variations for Tig welding this metal. Special attention is again given to inert-gas shielding.

★ (For a reprint of this article, circle number 250.)

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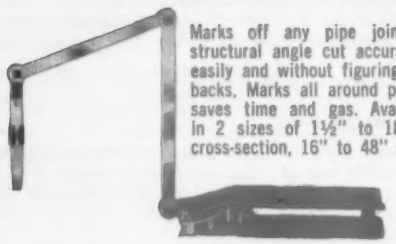

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THIS scene from last year's ASM Exposition will be repeated this year at Chicago's International Amphitheatre as registrants gather for the 41st exhibit, Nov. 2 through 6.

41st ASM exposition, congress to be held in Chicago, Nov. 2-6

For the 41st year the American Society for Metals will stage a National Metal Exposition and Congress—this time at Chicago from Nov. 2 through 6.

Theme for the annual meet is "Materials and fabrication preview of the soaring '60's." The exposition will be held in the International Amphitheatre and the Congress in several hotels.

Taking part in the congress, in addition to the ASM, will be seven cooperating groups. Coordinated and related programs are scheduled by American Institute of Mining, Metallurgical and Petroleum Engineers; Society for Nondestructive Testing; Special Libraries Association; American Society for Testing Materials; Metal Powder Industries Federation; Metal Treating Institute; and the Ultrasonic Manufacturers Association.

General theme of the Society for Nondestructive Testing is "Reliability and nondestructive testing." Subjects to be covered include inspection of brazed honeycomb structures and nuclear component reliability. SNT meetings will be held in the Hamilton Hotel.

Three papers covering uses of ultrasonics will be given at the Ultrasonic Manufacturers Association meeting Nov. 5 in Hotel Sherman. Among topics to be discussed are welding, brazing and soldering.

During the week William Park Woodside Panel Conferences will be held in the Sherman. Discussions will cover explosive forming, refractory metals, and new fabricating techniques.

The ASM's transactions committee selected for presentation 52 technical papers blanketing the metallurgy field. Subjects fall into several categories: titanium, high strength steels, steel I and II, creep and deformation, physical metallurgy, mechanical working, nuclear metals, austenitic alloys and refractory metals.

As part of the schedule, the ASM will conduct its annual business meeting on the morning of Nov. 4. The Campbell Memorial Lecture will be given, as part of the program, by Dr. A. R. Troiano, professor of metallurgy, Case Institute of Technology, Cleveland.

Walter Crafts, Union Carbide Metals Co., will be officially elected president of ASM at the morning session. Also to be elected are: vice president—W. A. Pennington, professor, University of Maryland; treasurer—R. J. Raudebaugh, International Nickel Co.; and trustees—A. H. Fairchild, Western Electric Co., and Carl H. Samans, Standard Oil Co. (Indiana).

Among the Exhibitors

American Brake Shoe Co.	727
American Chain & Cable Co.	953 & 1236
American Optical Co.	309
American Pullmax Co., Inc.	1705
Arcair Co.	1798
Balteau Electric Corp.	120
Eastman Kodak Co.	1429
Engelhard Industries	1430
Fenway Machine Co., Inc.	1054
Haynes-Stellite Div.	527
High Vacuum Equipment Corp.	1356
Magnaflux Corp.	865
Mitchell Radiation Products Corp.	220
NRC Equipment Corp.	1227
Narda Ultrasonics Corp.	1628
Picker X-Ray Corp.	126
A. O. Smith Corp.	1446
Tempil Corp.	225
Union Carbide Corp.	527
Westinghouse Electric Corp.	1630

NEWS

Hobart school teaches pressure pipe welding

A special training course on the welding of pressure piping is now available at the Hobart Welding School, Troy, Ohio.

The course is open to trained and experienced welding operators only, and features the "uphill" techniques of starting at the bottom of the joint and welding to the top. Upon completion of the course, the operator should be able to pass the Performance Qualification of Section IX, ASME Boiler and Pressure Vessel Code.

The course contains lectures and demonstrations covering all position groove welding, flame cutting bevels on pipe, pipe layout, welding root pass in fixed horizontal position, intermediate passes and beads in fixed horizontal position, and cover pass welds in the fixed horizontal position.

There is also supervised practice of root pass welding, intermediate pass welding and cover pass welding, and pre-test practice. Weldors make test welds on butt joints in 8-in. pipe in the horizontal fixed position.

The average welding operator can finish the course in four weeks.

Peoria conducts first AWS weld symposium

The Peoria (Ill.) section of the American Welding Society, will present its first annual welding symposium on Saturday, December 5, at Bradley University.

During the afternoon, Omer Blodgett, design consultant at the Lincoln Electric Co., Cleveland, will lead a discussion on "Design for welding." Anthony Pandjiris, president of Pandjiris Weldment Co., St. Louis, will discuss "New ideas in machine tools for welding," and Helmut Thielsch, metallurgical engineer, Grinnel Co., Providence, R. I., will speak on "The science of welding inspection."

A banquet, at Vonachen's Junction, will be dedicated to Elmer Isgren, executive vice president in charge of manufacturing at the LeTourneau Westinghouse Corp. in Peoria.

Also at the dinner, Fred Plummer, national secretary of AWS, will talk on "Activities of the American Welding Society."

ONE of six liquid oxygen trailers made of Kaiser aluminum for use by National Cylinder Gas.

Mig-welded transports carrying NCG products

A fleet of six all aluminum, Mig welded semitrailers are transporting liquid gases cross-country for the National Cylinder Gas Div. of Chemetron Corp., Chicago.

The carriers, used for storing, transporting and transferring liquid oxygen and nitrogen at temperatures just under their boiling points of —297 and —320 F respectively, were fabricated by the Boulder, Colo., division of Beech Aircraft Corp. All metal, approximately 10,000 lb per carrier, was supplied by Kaiser Aluminum & Chemical Sales, Inc., Oakland, Calif.

Aluminum increases the carrying capacity of each semitrailer by 40,000 cu ft of equivalent oxygen gas, while reducing the over-all loaded weight of the carrier by 9,000 lb.

Each carrier is two concentric tanks separated by a 6-in. vacuum space which is filled with an expanded silica insulating material. The inner tank is suspended inside the outer by a system of adjustable cables which were preset and safety wired at the factory. Four aluminum baffle plates in the inner vessel serve as thermal conductors to reduce liquid stratification and eliminate liquid splash.

Aluminum-magnesium-manganese alloy 5083 was used on the carriers. They are 32 ft 4 in. long, 8-ft wide and 10-ft 10 in. tall. Each has a 3,990 gal capacity.

Both inner and outer shells are Mig welded. The inner tank is protected by a safety rupture disc designed to rupture at 44 psi. An additional relief valve is provided which is set to open at 30 psi.

Alloy Rods sets up hardfacing division

Alloy Rods Co., York, Pa., has organized a hardfacing division to be operated as a separate sales group for the company. Einar Iverson, of the company's Chicago office, has been named manager of the division and will headquarter at the firm's main offices.

Iverson's former territory in the Chicago area will be taken over by Robert Mann. Mann has been working as field representative out of the Chicago branch for the past year.

Bridge design competition underway for 31st time

New steel bridges with outstanding aesthetic features will bring awards to their designers, fabricators and owners in the 31st annual competition being conducted by the American Institute of Steel Construction, New York City.

Steel bridges erected anywhere in the United States and opened to traffic in 1958 are eligible for awards in four classifications: (1) bridges with one or more spans 400 ft or longer, (2) bridges costing over $500,000 with fixed spans but none more than 400 ft long; (3) bridges costing less than $500,000 with fixed spans; (4) bridges with movable spans.

(All-welded award winners from the 30th annual competition are pictured elsewhere in this issue.)

COMING EVENTS

OCT. 19-20: NWSA West Central Zone Meeting, Pick-Nicolett Hotel, Minneapolis.
OCT. 19-23: 47th National Safety Congress and Exposition, Chicago.
OCT. 22-23: NWSA Western Zone Meeting, Riviera Hotel, Las Vegas.
NOV. 2-6: 41st National Metal Exposition and Congress, International Amphitheatre, Chicago.
NOV. 19-20: University of Wisconsin Annual Welding Institute, "Stainless Steel Welding," Wisconsin Alumni Center, Madison.
NOV. 30-DEC. 1: NWSA Southeastern Zone Meeting, Atlanta Biltmore Hotel, Atlanta.

Nebraska tech school expands welding technology course

The Nebraska Vocational Technical School, Milford, has expanded its welding technology sequence to a two-year program requiring 132 credits for a diploma.

The curriculum consists of courses on basic arc welding and oxyacetylene welding, semiautomatic and automatic inert arc welding, cutting, hardfacing and the use of jigs and fixtures.

Other courses included are physics for technicians, mathematics, shop drawing and blueprint reading, purchasing procedures, certification, metallurgy and human relations for business and industry.

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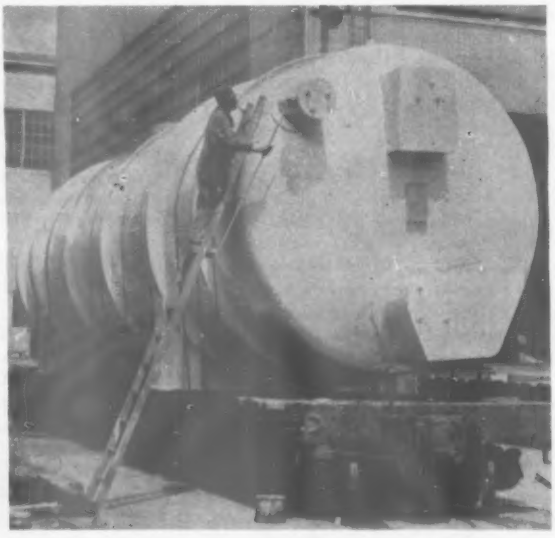
(Additional news on page 83)

Big tank for air force



WORKMAN at Chicago Bridge & Iron Co.'s Chicago plant puts final touch on 60-ft long tank before its shipment to Warren Air Force Base, Cheyenne, Wyo., site of an Atlas Inter-continental Ballistics Missile Base. Tank will store liquid oxygen. Double-walled vessel—one of 12 identical 28,000-gal structures built by CB&I—has a 9½-ft diameter inside shell of stainless steel and an 11½-ft diameter outside shell of carbon steel.

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An economy outfit can be economical only if it will perform well and for many satisfying years to come. If it fails to meet highest standards, it ceases to merit all consideration . . .

Extendable? By all means. This Five Star Pak is amazingly versatile. It may be extended as the needs expand. Larger or smaller nozzles or tips fit the torches as do multiple flame nozzles so convenient for many brazing operations. The cutting attachment, for instance, may cut easily up to four inches of steel thickness.

You can buy with confidence from a company which has been in the business of making fine equipment for nearly fifty years.

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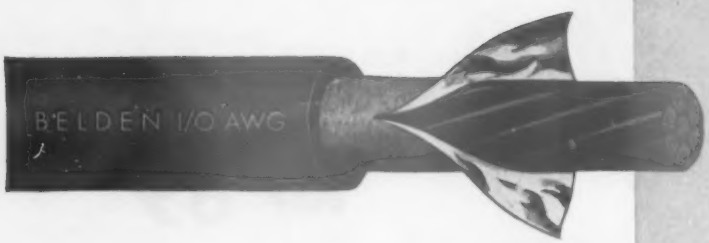

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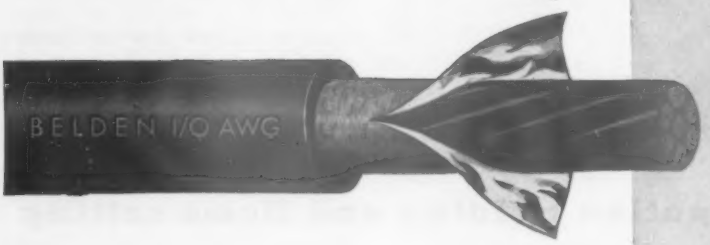

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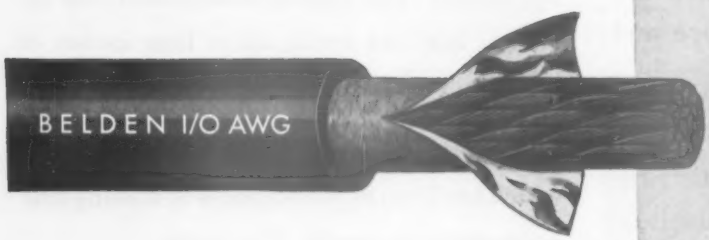
Resist oil, grease, heat, sunlight, mechanical abuse, and ozone set up by high frequency welding or atmospheric conditions.

HVF Vinyl Plastic-Jacketed Cables
High voltage-frequency vinyl insulation affords perfect resistance to corona and ozone cracking . . makes this cable ideal for high frequency welding. High resistance to abrasion, oil, and impact.



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Hawser lay construction of conductor makes this cable extremely limp and manageable . . minimizes operator fatigue. Jacket won't pull away from electrode holder. Neoprene insulation.

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ask your welding supply distributor

one wire source for everything electrical and electronic

magnet wire • lead wire • power supply cords • cord sets • portable cordage • electronic wire • automotive replacement wire and cable • aircraft wire • electrical household replacement cords

Belden
WIREMAKER FOR INDUSTRY
SINCE 1902
CHICAGO

18-1-9

This is all the room you need to weld with LINDE's "MIGHTY MIDGET"

SHOWN ACTUAL SIZE IN 3-IN. OPENING

. . . New Heliarc HW-20 Torch

HIGH CURRENT CAPACITY

Operates at 200 amperes *continuous* duty, AC or DC. Molded, totally closed water-cooling system eliminates any chance of leaks at torch head.

MINIATURE SIZE

9/16- by 2-5/16-in. torch head permits welding in hard-to-reach areas as small as 3 in. in diameter. Total torch length is under 7 inches.

3.3-OZ. FEATHERWEIGHT

Selected materials, such as glass fiber reinforced phenolic plastic, save weight without sacrificing strength. Torch (with short cap) weighs only 3.3 ounces.

HANDLES LIKE A PENCIL

Exceptional balance, light weight, small size, and super-flexible service lines make the HW-20 torch as easy to handle as a pencil.

For further information, call your local LINDE Office or LINDE Distributor . . . or write: Dept. WE-10, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, New York.

The terms "Heliarc," "Linde," and "Union Carbide" are registered trade marks of Union Carbide Corporation.

SPECIFICATIONS

Capacity—
200 amp. AC or DC, continuous duty cycle;
225 amp. AC or DC, reduced duty cycle

Weight—
with short cap: 3.3 oz.*
with medium cap: 3.5 oz.
with long cap: 3.6 oz.

Length overall—6⅞ in.

Length of Torch Head—
with short cap: 2-19/64 in.*
with medium cap: 3-9/32 in.
with long cap: 7-5/16 in.

Maximum Handle Diameter—¾ in.

Maximum Head Diameter—9/16 in.

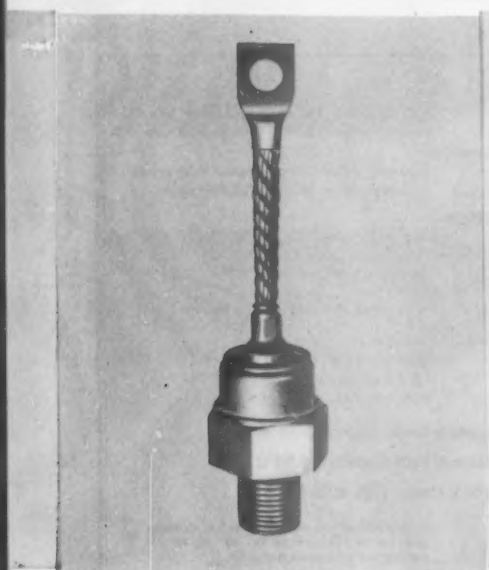
Service Lines—12½ or 25 ft.

*Torch is supplied with medium cap for 3-in. electrodes. Short cap for 2-in. electrodes and long cap for 7-in. electrodes are available as accessories.

Linde UNION CARBIDE

new . . . Silicon Type WS

200, 300, 400 and 500 Amperes
230/460 Volts
60% Duty Cycle



Silicon diodes in the three-phase, full-wave rectifier are the heart of the WS welder. These diodes have a capacity far in excess of the rating for the welder and are hermetically sealed against dust, oil, water and acid fumes by a new bonding process. Each diode is thoroughly tested before and after insertion in the bridge.

Watch Westinghouse for New Developments in Welding

Rectifier Welder

- *Maximum Performance at Minimum Cost*
- *Highest Degree of Electrical Efficiency*
- *Most Compact Welder in the Industry*
- *Extremely Low Maintenance*

The Type *WS* silicon rectifier welder reflects engineering skill of the highest order. This welder is designed for maximum performance and reliability. It is a product of experience—developed in the Westinghouse laboratories and tested in the field under a variety of conditions. The welder you purchase will be checked out in every detail before it leaves our factory. Every conceivable precaution has been taken to assure you of a faultless piece of equipment.

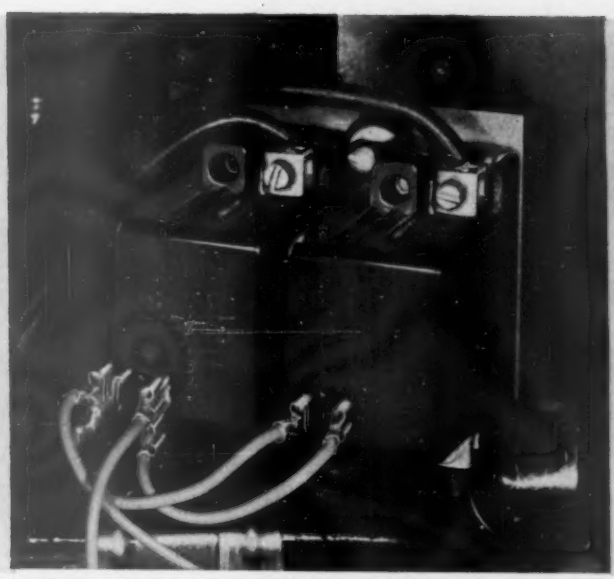
Westinghouse pioneered this completely new concept in industrial welding machines over 10 years ago. Since that time another refinement of the rectifier-type welder was achieved by Westinghouse through the use of silicon diodes. The ultimate in silicon rectifier machines is the Westinghouse Type *WS*.

No other welder on the market has the electrical circuitry to produce sound quality welds as consistently as the *WS*. It provides easier starting, arc stability and maximum drive. Silicon rectification means top welding performance.

The *WS* is the lightest, smallest machine on the market. It is easy to handle and is a space saver. Its bonderized steel casing, protected by baked-on enamel, gives it a weatherproof construction. The high-quality materials in this welder will render long life and trouble-free service.

Learn more about this reliable source of power for welding!

Contact your nearest franchised Westinghouse welding distributor—or write: Welding Division, Westinghouse Electric Corporation, 4454 Genesee Street, Buffalo 5, New York. J-22150



The inverse time relay shown here allows adequate time delay for arc starting at high current setting and freedom from nuisance power interruptions—yet it protects against serious short circuit faults. Capacitors divert and store peak, high-value, short-time voltage spikes that occur when electrical current is broken.

The Type WS has virtually no moving parts to wear out; thus, replacement is at a minimum. The easy access panel shown here makes routine maintenance and air cleaning of the rectifier bridge a fast, simple operation. Be cost-wise, avail yourself of this extremely low maintenance!

YOU CAN BE **SURE**... IF IT'S **Westinghouse**

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV FRIDAYS

WELDING ENGINEER

Your October, 1959

Weld World

As WE went to press, these were the industry's latest developments:

. . Square D Co. is moving its corporate executive offices from Detroit to the Chicago area. Ground will be broken this month for a 43,000-sq-ft building in Park Ridge, a northwestern suburb, and the electronic-controls firm hopes to make the move by next summer.

. . High Vacuum Equipment Corp., Hingham, Mass., which recently introduced an electron-beam welder, has become a wholly owned subsidiary of Robinson Technical Products, Inc., Teterboro, N.J.

. . American Brass Co. and the International Union of Mine, Mill and Smelter Workers reached an agreement on a new contract. American Brass had not been struck as is about 75% of the copper industry. Price hikes—one to 33 cents per pound—were reported by some producers still operating, but Kennecott and Phelps Dodge said they would keep 30-cent price while strike lasts.

. . In the midst of the steel strike, R. G. LeTourneau, Inc., Longview, Texas, announced that it is offering its Steel Division products to the open market. Included is a high strength, weldable, nickel-alloy plate. Previously, output of the 300-ton-per-day mill primarily has gone to supply the firm's manufacturing facilities at Longview and Vicksburg, Miss.

. . All barometers point to a resumption of the boom which the steel industry was experiencing before the strike began. One indicator: prices of scrap are up, one premium grade bringing as much as $45 per ton.

. . Eight of Worthington Corp.'s 20 U. S. plants were struck by the United Steelworkers and the International Association of Machinists. Contract had ended June 1, but work continued until mid-September while negotiations went on. Among the eight struck plants were those at Plainfield, Harrison and Newark, N. J.

. . Electron-beam welding equipment is being produced by Sciaky Bros. Inc., Chicago, a leading manufacturer of resistance-welding machines and controls.

miller
WELDERS

BIG TWIN
250 AC/DC

LITTLE TWIN
180 AC/DC

AND BOTH MILLERS . . . Through and Through

BIG TWIN combination ac-dc welders work from single phase service — deliver new convenience and economy. Two a-c amperage ranges of 20-125 and 60-290 plus two d-c ranges of 18-100 and 65-290 amps master nearly every welding requirement from light gauge metal to structural pieces. Movable shunt type transformer affords infinite current adjustments. Other features include: Horizontal design for easy stacking; weather-resistant construction and Class B insulation; Miller-built semi-metallic rectifier for best d-c welding; high open circuit voltages and new weld stabilizer. This is THE all-time, all-around welder!

LITTLE TWIN ac-dc combination welder has two a-c amperage ranges of 20-115 and 60-180 plus one d-c range of 40-150. Operating from single phase service, this Miller model incorporates many design and construction features usually found only in large industrial types. These include really rugged construction, forced air cooling, new Miller semi-metallic rectifier, movable shunt type current control, new weld stabilizer and open circuit voltage in abundance. Power factor correction is available on both models. Complete specifications on either model will be sent promptly upon request.

miller ELECTRIC MANUFACTURING COMPANY, INC. • APPLETON, WISCONSIN

Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal

EXPORT OFFICE 250 West 57th St., New York 19, N. Y.

HARRIS

universal pressure welding torch No. 43 and the No. 49 cutting attachment will

make it possible to average

18% MORE acetylene from your cylinders

outstanding features:

1. All welding assemblies and cutting attachments operate on *less than 1 pound* of Acetylene, permitting complete withdrawal of all the gas.
2. Safer . . . virtually impossible to back oxygen into acetylene line.
3. Exceptional Flame Stability, due to unique mixing principal.

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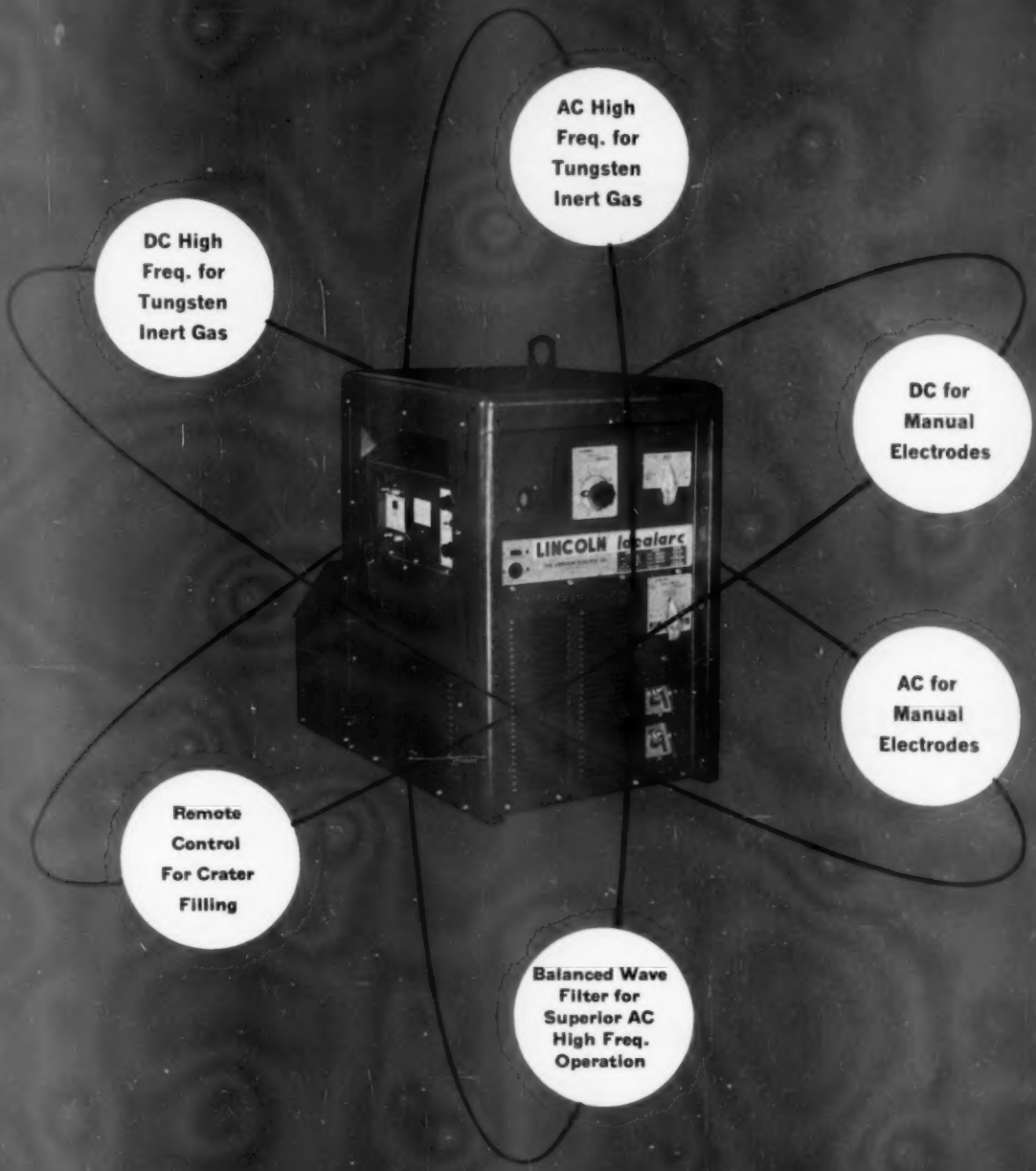
5501 CASS AVE. • CLEVELAND 2, OHIO

LINCOLN WELDERS

"IDEALARC TIG"

AC & AC/DC ARC WELDERS


AC High Freq. for Tungsten Inert Gas
DC High Freq. for Tungsten Inert Gas
DC for Manual Electrodes
AC for Manual Electrodes
Remote Control For Crater Filling
Balanced Wave Filter for Superior AC High Freq. Operation
LINCOLN idealarc

SELECT ANY OR ALL OF THESE FEATURES IN THE NEW "TIG" MODELS

1

AC Inert Gas

DC Inert Gas

AC Manual Electrode

DC Manual Electrode

ONE MACHINE

...FOR ALL MANUAL ARC WELDING APPLICATIONS

Now for the first time, users of arc welding can obtain a machine tailored to their own specific needs at the low cost of volume production equipment.
Two 300 ampere models, AC and AC/DC, can be equipped with High Frequency with gas and water controls, or any other feature required, at the factory. The buyer is free to select only those features he needs, thereby eliminating needless expense of purchasing unnecessary capabilities.

BASIC EQUIPMENT

The heart of the Idealarc TIG welder is a completely new saturable reactor transformer welder with plenty of capacity and exceptional arc characteristics. It is an excellent AC arc welder capable of handling a wide range of AC arc welding applications. This straight AC Idealarc is known as Model TIG-300.

The TIG-300/300 AC/DC Idealarc is actually the same high-quality AC welder with rectifiers, line contactor and other necessary circuitry added. This model has the same excellent AC welding characteristics, plus DC—at the flip of a switch.

The following features make either type Idealarc TIG welder an outstanding machine.

SELECTOR SWITCH

The selector switch on the combination AC/DC models has DC+, DC— and AC positions. A new design, it is rugged and capable of standing heavy use under severe conditions.

CONVENIENT CURRENT CONTROL

A selector switch divides the TIG's 10 - 375 ampere output into three easily adjusted narrow ranges:

	Position 1	Position 2	Position 3
AC amps.	10 to 75	40 to 250	125 to 450
DC amps.	10 to 70	45 to 250	170 to 375

A rheostat control provides fine tuning within each range. Further, all machines accommodate remote current controls.

OVERLOAD PROTECTION

All AC/DC Idealarcs and all straight AC's equipped with line contactors have built-in overload protection. This prevents damage to the welder from excessive heat in the windings or rectifier, regardless of the source of heat.

INDICATOR LAMP

A red light provides a visible signal that the welder is turned on. This lessens the chance that the machines will be left on overnight or over the weekend when they should be turned off.

RECESSED CONTROL PANEL

The entire face of the machine is recessed to prevent accidental damage to the controls. Output studs are recessed still further to give added protection against accidental short circuits across them.

STRAIN RELIEF LOOP

A rugged strain relief loop under the output terminals restrains excessive tension on the cable to prevent loosened contacts, arcing and cable overheating at the studs.

AMPLE COOLING

A large fan forces quantities of clean air from the top of the welder down over rectifier stacks and windings and out the bottom. This provides ample rectifier cooling without sucking dust and dirt from the floor through the machine.

Every "Idealarc TIG" Welder Has All These Features

Basic Price
AC Only $360 AC/DC $625

CONVENIENT MAINTENANCE

Maintenance personnel really appreciate the accessibility and ease of maintenance of the Idealarc TIG models. The sides of the machine remove easily and individually for routine inspection and cleaning. All parts are readily accessible.

SINGLE PHASE POWER

The Idealarc TIG welder can be used on any type of AC power source because it is a single phase machine. It is not limited to three phase power supply.

CONNECTS TO TWO VOLTAGES

All TIG model welders for 220/440 volts or 220/550 volts are reconnectable. On machines with line contactors this is done without changing any leads by merely moving a contact plate. The panel automatically reads the voltage for which it is connected.

OPTIONAL EQUIPMENT

Optional equipment converts the basic TIG-300 or TIG-300/300 Idealarc welder into a deluxe machine for all types of tungsten inert gas welding. Other features provide added convenience in using the machine. All may be factory-installed as integral parts of the machine and some are also available as a kit for field installation.

HIGH FREQUENCY And INERT GAS CONTROL

This feature provides all controls necessary for any tungsten inert gas welding. It can be set to operate in any of the following ways with either AC or DC:

Select Any or All These Optional Features

Price Including All Options
Except 115V Pushbutton and Undercarriage
AC $816 AC/DC $1041

1. High frequency, continuous during arc time, with gas and water control.
2. High frequency for arc start only, with gas and water control.
3. No high frequency, but water and gas control.
4. No high frequency, no water and gas control.

Two switches provide the above choices. The first is a master switch that turns the whole high-frequency unit, including gas and water controls, on and off. When it is in the "on" position, the second switch selects continuous spark, start-only spark or no spark without affecting the gas and water controls.

A timer adjusts the gas and water after-flow time. It is set according to electrode size.

There is no welding power or high-frequency output, except when welding. Cable and torch are electrically, "cold" and safe. To weld, the operator depresses a remote switch which attaches to the torch. This closes an output contactor to apply high-frequency and welding current. When the arc is extinguished, the contactor opens automatically.

† Zone 1 Prices

REMOTE CURRENT CONTROL

With the convenient Amptrol remote current control, operators adjust current while welding to compensate for varied welding conditions and for crater filling. It controls current from minimum amperage of the range set on the machine to the maximum amperage set on the fine tuning control. It comes with 25 feet of electrical cord and a three-pronged plug which fits the receptacle on the welder. Amptrol is available in either hand- or foot-operated models.

BALANCED WAVE FILTER

Recommended when an AC high frequency is used, the filter eliminates the distorted wave shape and DC feedback current created by the arc. It provides smooth operating characteristics over the entire current range and maintains the machine's rated output at 50% duty cycle. It includes three, 6-volt automotive storage batteries and a trickle charge circuit to keep them fully charged. Equipped with a switch, the trickle charge can be turned off when not needed. A quickly detachable (QD) connector is provided to take batteries out of welding circuit when not required.

POWER FACTOR CORRECTION CONDENSERS*

Power factor condensers improve power factor and reduce input current. With them, it is possible to install lighter input leads and reduce KVA power demands.

LINE CONTACTOR

You start the Idealarc TIG with a pushbutton on the front of the machine. This operates a magnetic contactor type starter, which is connected to provide overload and overheating protection for the rectifier and windings. The line contactor is standard equipment on AC/DC models; optional on straight AC models.

115 VOLT PUSHBUTTON CONTROL

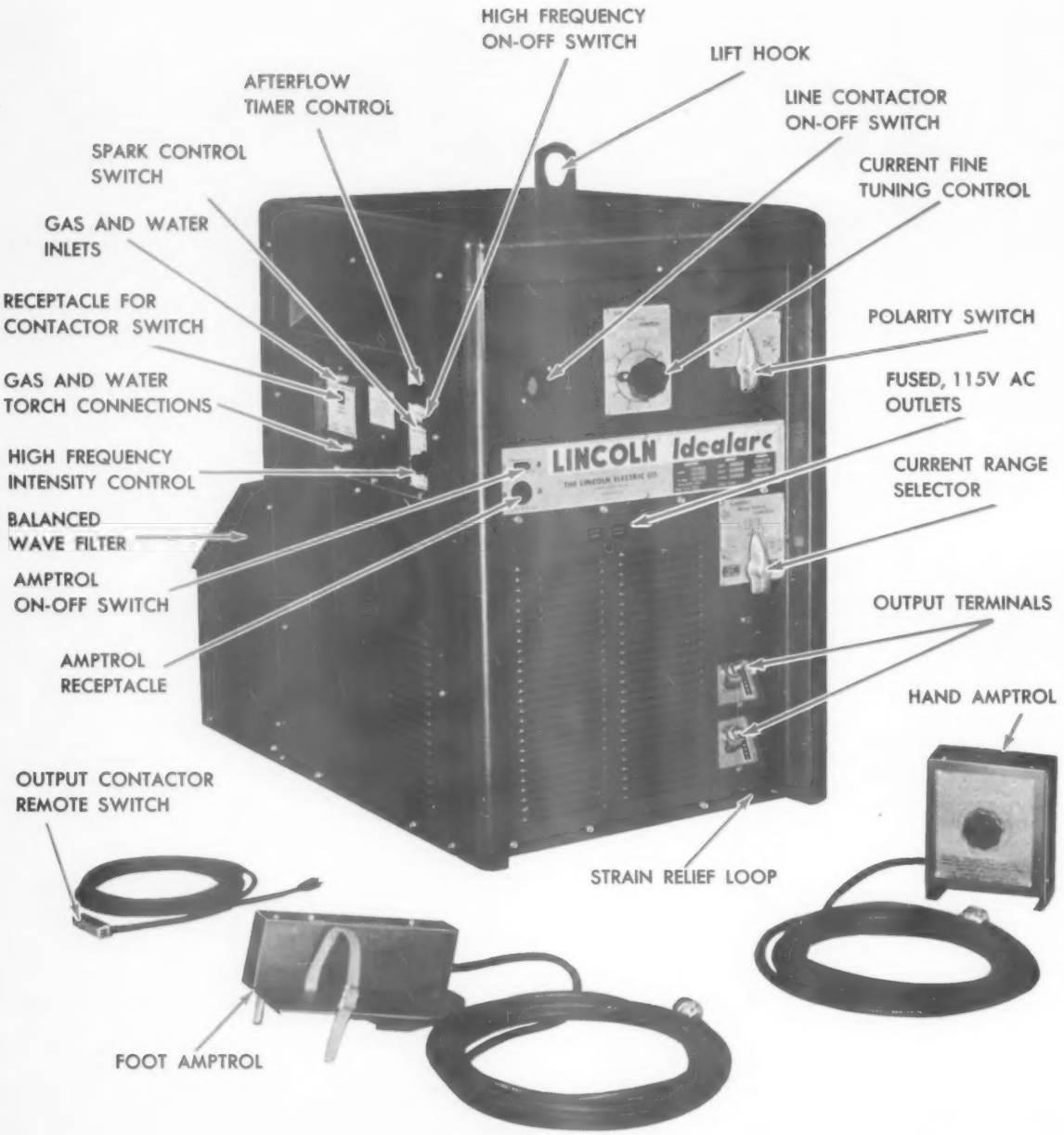
This feature modifies the pushbutton circuit on the line contactor so it meets special safety regulations which require that pushbuttons operate only in 115 volt circuits.

UNDERCARRIAGES*

Heavy duty, three-wheeled undercarriages provide convenient portability for machines that frequently move from one place to another in the shop. Available with either steel or solid rubber tired wheels, the undercarriage pulls easily and requires little extra floor space beyond that required for the welder itself.

* Available in a kit for field installation.

Lincoln "Idealarc TIG" Arc Welder



FOR ALL MANUAL ARC WELDING APPLICATIONS

APPLICATIONS

Idealarc TIG welders are exceptionally versatile welding machines. No other welder offers all the features available on these Idealarcs. No other machine can do so many arc welding jobs.

First, Idealarc TIG welders are especially applicable to tungsten inert gas welding of aluminum and other newer metals with AC and high frequency. The output characteristics are designed to provide an even wave shape that produces best arc characteristics and cleaning action. The wave filter automatically maintains these characteristics over the entire current range. This filter is the most simple and effective means of controlling the DC component in use today.

All necessary controls for tungsten inert gas welding are integral parts of the high frequency package. Smooth remote control, so necessary in crater filling, is available. In short, Idealarc TIG welders have everything required in a machine for AC, high frequency, inert gas welding.

Further, direct current with high frequency is used for tungsten inert gas welding of stainless and some alloy steels. Idealarc TIG welders are ideal for this type of work too. Again, they have everything necessary to do the job.

In addition, Idealarc TIG is an excellent machine for all conventional, coated electrode, applications. AC or DC, convenient controls, good arc characteristics, ample current range, and many other features provide plenty of operator appeal and outstanding welding performance. Job shops and maintenance departments particularly appreciate the ability to handle, with one machine, both their routine work and the aluminum or other special jobs they encounter.

Idealarc TIG is truely an exceptionally versatile machine for both inert gas and conventional electrode welding.

(Note: If your welding requires only conventional coated electrodes, see Bulletin 4607.1 which describes the model TM Idealarc welder.)

SPECIFICATIONS

Model	TIG-300	TIG-300/300
Type 60 cycle	K-1130	K-1131
50 cycle	K-1132	K-1133
NEMA Output		
Amperes	300	300
Arc Voltage	40	40
Duty Cycle	60%*	60%*
Output Current Range		
AC	10-450 amps.	10-450 amps.
DC	....	10-375 amps.
Input Current (on 220V and at rated output)		
With Condensers	84 amps.	92 amps.
Without Condensers	108 amps.	108 amps.
Weight (Approx.)		
Net	630	760
Shipping, Domestic	680	820
Shipping, Export	800	950

INPUT POWER

Volts:	208, 220/440 or 220/550
Phase:	Single (or any one of 2 or 3)
Cycles:	60 or 50
Special Voltages:	220/380 and other single voltages available at slight extra charge

DIMENSIONS

	Height	Width	Depth
Machine, overall	44⅞"	26⅛"	28½"
Export crate	59⅜"	35¼"	37⅞"
Mounting Holes (centers, ⅝" x ⅞" slots)		28⅛"	14½"

* On AC Inert gas applications this is reduced to 50% when using wave filter and to 35% without aid of wave filter.

LINCOLN ...USA

THE LINCOLN ELECTRIC COMPANY

The World's Largest Manufacturer of Arc Welding Equipment!

CLEVELAND 17, OHIO

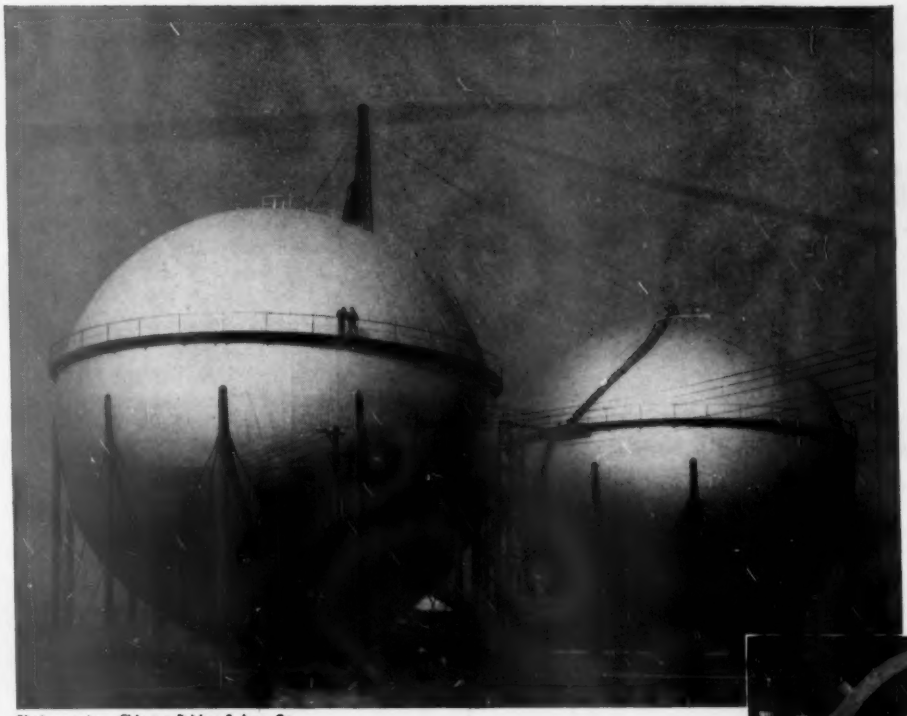


Photo courtesy Chicago Bridge & Iron Co.

When there's no margin for error...specify

ATOM-ARC ALLOYS

FOR WELDING

Low Alloy or High Strength Steels

With continually increasing fabrication costs, you can't afford a *margin for error*. Successful fabricators specify the inherent qualities of all position iron powder low hydrogen Atom Arc electrodes to reduce the unnecessary rework that chews up profits and delays jobs.

Inspection by X-ray is a requirement for most fabrications involving low alloy or high tensile steels. There is an Atom Arc alloy with the right physical properties and chemistry for welding most low alloy or high tensile steels. An electrode that deposits X-ray sound weld metal, increases the efficiency of your welding operation and lowers your costs. For complete details write for the "Handbook for Welding Low Alloy High Tensile Steels," Alloy Rods Company, Dept. 02, P. O. Box 1828, York, Pennsylvania.

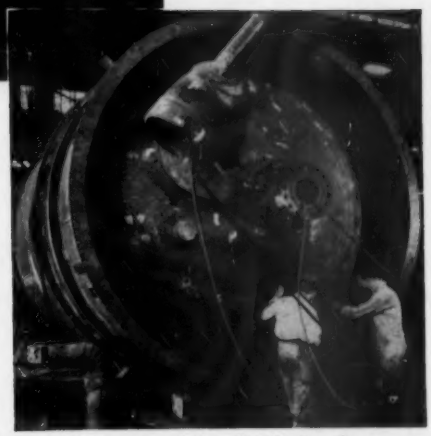


Photo courtesy Baldwin-Lima-Hamilton Corp.

Atom Arc 7018 Mo
AWS-E7018-A1

Atom Arc 8018 N
AWS-E8018-C2

Atom Arc 8018 CM
AWS-E8018-B2

Atom Arc 9018 CM
AWS-E9018-B3

Atom Arc 10018 MM
AWS-E10018-D2

Atom Arc 12018 NMV
AWS-E12018-G

Atom Arc T
AWS-E11018-G

Alloy Rods Company

YORK, PENNSYLVANIA ■ EL SEGUNDO, CALIFORNIA

QUALITY WELDING ELECTRODES FOR
Stainless Steel
Low Alloy Steels
Cast Iron
Tool Steel
Bronzes & Dissimilar Metals
Hard Surfacing Electrodes & Wires

NO FINER ELECTRODES MADE . . . ANYWHERE

How Harry Grieger

Harry F. Grieger is general manager of one of New England's thriving industrial distributing organizations, New Haven's Coe & Brown Company. In the business for more than ten years, Harry Grieger started out with a well-known competitive line of abrasive products and found they just didn't meet his standards. Switching to Bay State, he has built his business rapidly and credits Bay State products and service with a "considerable share in this company's growth."

unclogged a bottleneck at Pioneer Manufacturing

When a company has to work double shifts to keep up with customer demand, it's a pretty sure sign that the company *demands top efficiency* from its suppliers.

That's certainly the case with Pioneer Manufacturing Co., Inc. of New Haven, Conn., manufacturers of engineered sheet metal and welded products. Working with both ferrous and non-ferrous metals, they found that the weld-grinding wheels they'd been using loaded up so fast that the down-time situation was getting out of hand and weld-grinding had become an infuriating bottle-neck.

That was when Pioneer Manufacturing called in Bay State distributor, Harry Grieger, General Manager of Coe & Brown Company. He discovered that the only surprising thing about the situation was how easily it could be solved. He simply specified Bay State's Blue Flash, raised hub disc-wheels and the bottle-neck vanished . . . because Blue Flash wheels cut cost and consistently gave a higher rate of stock removal than any other wheel on the market. As a result, production zoomed, the portable grinder operators were delighted and the customer was more than slightly pleased with the improvement in the company's profit picture.

Like Harry Grieger, the Bay State distributor in your area is a trained abrasive specialist. He's as glad to tackle tough problems as he is simple ones and you'll find he's a mine of ideas on ways to improve grinding technique and cut abrasive costs . . . because *better grinding at lower cost, that is his business.*

BUY THROUGH YOUR INDUSTRIAL SUPPLY DISTRIBUTOR

Operator Lawrence Jennette grinds weld bead on steel brace for frame of vibration test equipment, designed for aircraft and missile manufacturers *(guard removed for photography).*

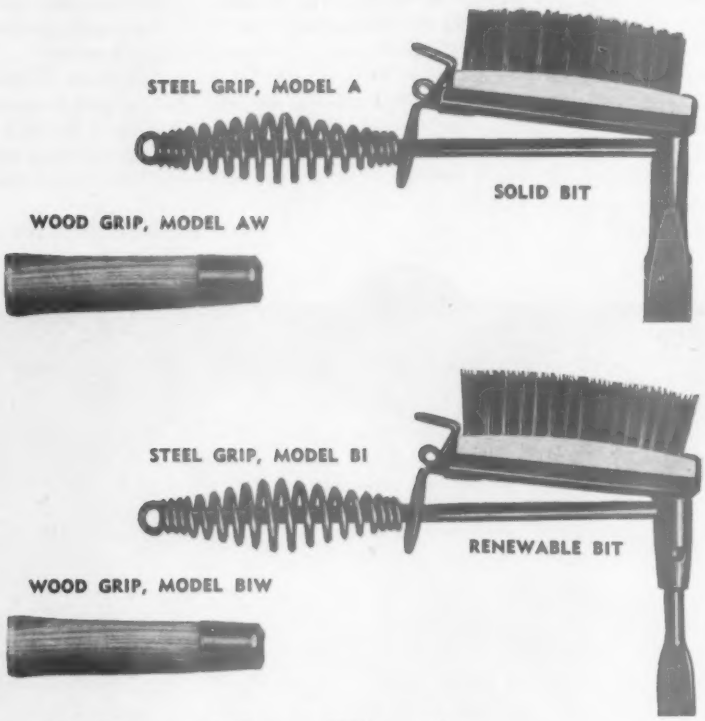
BAY STATE ABRASIVES

BAY STATE WHEELS of PROGRESS

Bay State Abrasive Products Co., Westboro, Massachusetts.
In Canada: Bay State Abrasive Products Co., (Canada) Ltd., Brantford, Ontario.
Branch Offices: Bristol, Conn., Chicago, Cleveland, Detroit, Pittsburgh, Los Angeles. *Distributors:* All principal cities.

ATLAS | WIDE - BLADE TOMAHAWKS

WORLDS LEADING WELD CLEANING TOOLS



If Possible—They're Better than Ever!

Atlas "Dual Tools" are favorites with welders who like the idea of having the brush handy at all times. Now these tools are even more efficient than ever with our new wide blades—18% more chipping edge, more speed, fewer resharpenings, less worker fatigue. Choose your "Dual Tool" with the grip you prefer and the bit that best suits your likes. Ask your dealer for our FORM WCT-250 describing all our models.

Tough as they come!

33 MODELS

Each Atlas tool is made as well as we know how. Ask your welding supply dealer to show you the complete line.

ATLAS

WELDING ACCESSORIES INCORPORATED

707 E. LEWISTON

FERNDALE 20, MICH.

Letters . . .

Tank gallonage

Sir:

Would you please examine the problem in *The Welding Clinic* in the August issue ("How to determine tank gallonage," p. 38).

With the help of a math instructor we arrived at another answer. Please check our answer, and if it is incorrect, write and give a further explanation.

Ted Lyons
Don Maley

Sir: *St. Louis*

In reading your August issue, I found that your article in *The Welding Clinic* contains an incorrect formula for determining tank capacity.

I thought I should bring this to your attention for correction.

J. E. Boeckstiegel
Nordberg Mfg. Co.

—Both letters are right in questioning the accuracy of the formulae used in determining tank gallonage which appeared in the August issue. The correct formulae are as follows:

For an elliptical tank:
$capacity = 0.7854\ ab \times L \times 7.48$
For an oval tank:
$capacity = (0.7854d^2 \times de)\ L \times 7.48$

Editorial comment

Sir: *Atglen, Pa.*

May I comment on the editorial in the August issue of *Welding Engineer*, "Stupid—like a fox." While not in so many words, you so well bring to mind that old sales axiom, "Don't underestimate your competition."

Fred M. Turtle

Welding codes

Sir: *Troy, Ohio*

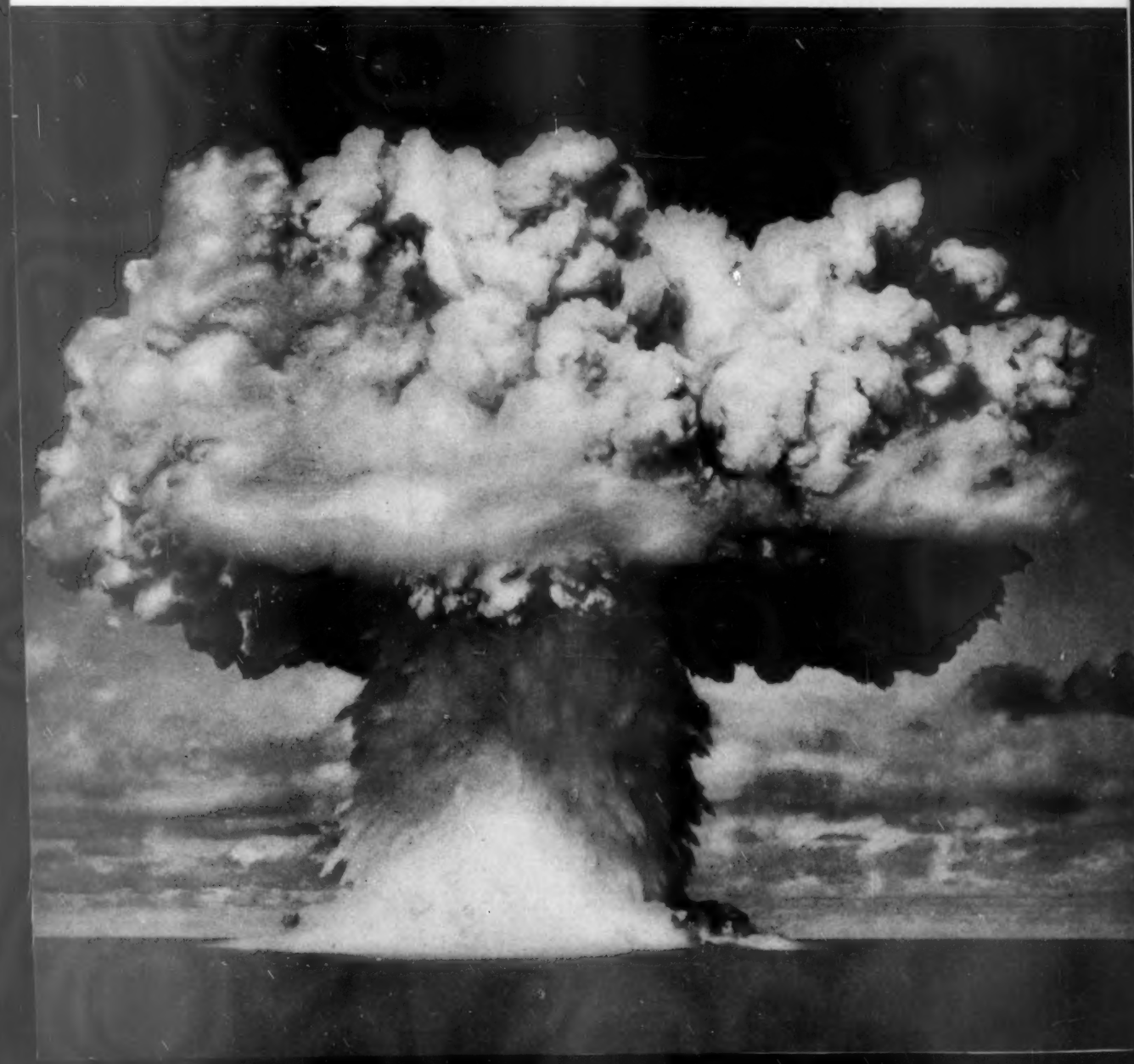
The welding code controversy has been raging for many years, and now is the time for some constructive action. Such codes are usually written by groups interested in protecting the public or for maintaining minimum quality standards. They are primarily used by purchasers and users of welded products, and

Letters should be addressed to: The Editor, WELDING ENGINEER, P. O. Box 28, Morton Grove, Ill. No letter will be published unless signed, but your name will be withheld if requested

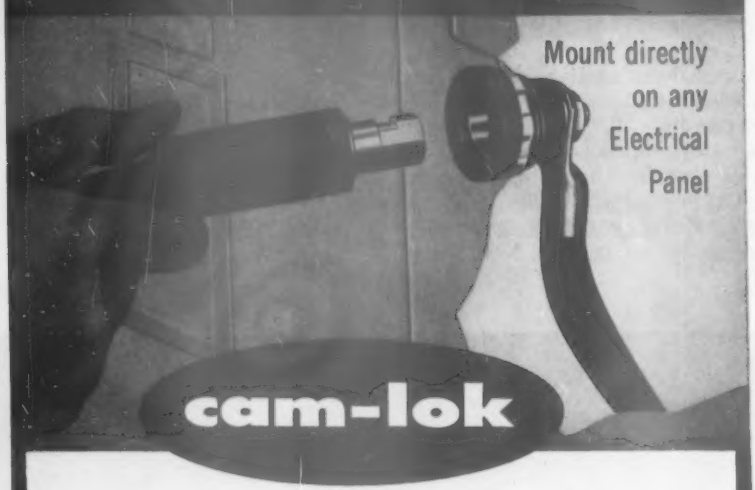
World's toughest test withstood by M&T Murex ELECTRODES

Behlen Frameless Metal Buildings have survived what's probably the world's toughest single test—a nuclear explosion. One of the prefabricated buildings was placed only 6,800 feet from blast center and remained erect. A duplicate building 15,000 feet away suffered almost no structural damage. In welding the components used in constructing churches, plants, schools, supermarkets, commercial and farm buildings, Behlen Manufacturing Company relies heavily on Murex electrodes – products of METAL & THERMIT CORPORATION, General Offices: Rahway, New Jersey.

MUREX
PRODUCTS FOR BETTER WELDING



New Hi-Impact Plastic Insulated
Panel Receptacles and Mating Plugs



Now, you can make fast, positive power connections to any metal panel or housing without special insulating materials. Simply punch out a hole and insert a Cam-Lok self-insulated Receptacle! Uses standard electrical lock-nuts, affords "dead-front" protection. Push in and twist Cam-Lok mating Plug and you've made a locked connection, which can be released quickly.

New Cam-Lok Receptacles eliminate costs of special insulating panels and reduce assembly time. Patented, high-pressure contact assures minimum resistance and heating.

Cam-Lok has a complete line of Receptacles and Plugs in many sizes and designs. Standard and special purpose Power Distribution Connections are available. Write today for new Bulletin No. 301.

"Dead Front" design for fast
direct mounting on . . .

• ELECTRICAL DISTRIBUTION PANELS • SWITCHGEAR
• BUS DUCT • JUNCTION BOXES
• WIREWAY or any electrical cubicle

A Complete Line of Welding Accessories and Special Power Distribution Connections

cam-lok
DIVISION

EMPIRE PRODUCTS, INC.
P.O. BOX N-98
CINCINNATI 36, OHIO

many times as the basis for price.

Codes are not written to hamper the use of a particular manufacturing process but to protect the life and property of the public. Those responsible for purchasing and using weldments produced under code are rarely those who severely criticize the codes.

Those who do criticize welding codes are usually in the welding industry but it is questionable if they would remove or eliminate the quality control specifications that they employ in purchasing or inspecting materials they use in their own products.

Codes and specifications have resulted from a particular situation or need . . . History provides the proof that because of the ASME Boiler and Pressure Vessel Code present-day high temperature and pressure boilers are in operation with minimum service difficulties. The same can be said for other codes.

We believe that much can be done to reduce the confusion surrounding the use of codes and tests . . . The American Welding Society has done a notable job of standardizing the welding provisions of the different codes. Much more work of this nature needs to be done . . .

An objective should be to provide more knowledge and better understanding of the provisions of the different codes. It is true that those involved with one code or codes covering similar work become extremely familiar with the specific requirements of that code. But, it is when a number of codes are considered together that they become confusing . . .

So suggestions for improvement can be offered, we will summarize the provisions found in many codes. They contain; scope, welding definitions, specimens and testing methods, design considerations including joint design, welding electrodes and base metals, inspection jurisdiction and acceptability standards, the qualification of processes, procedures and operators. These last two factors together with inspection requirements provide for the majority of welding tests.

Some of the codes provide standardized joint designs which have been prequalified. Additional work and research should be done to provide prequalified joint designs for all requirements. This would fulfill 95% of the designer's requirements . . .

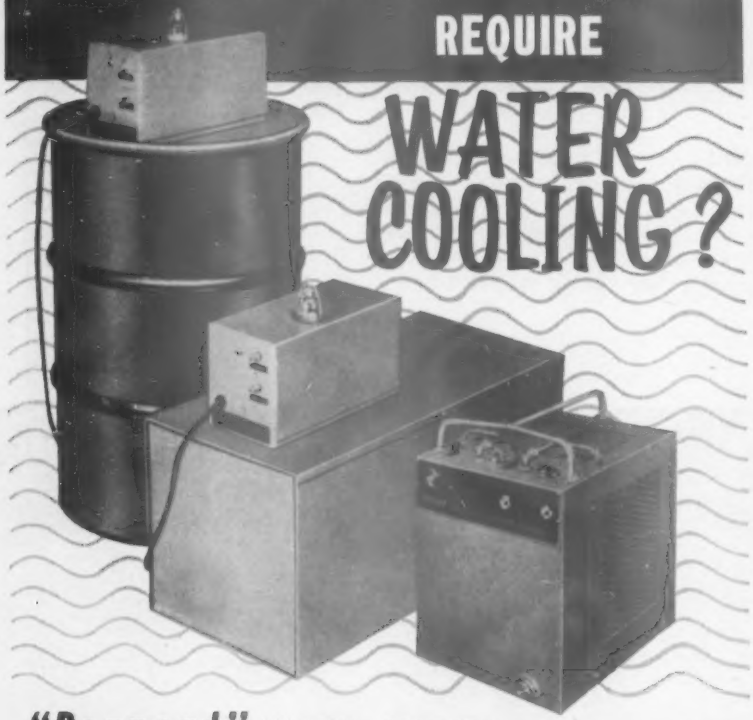
Prequalification of welding processes and procedures could also be made more universal. The pipe welding industry has made significant advances in providing prequalified joint designs and procedures which have greatly re-

World's safest safe welded with M&T Murex ELECTRODES

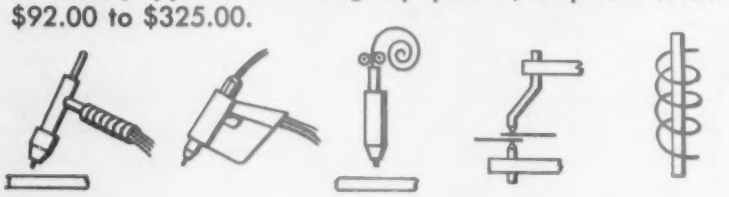
Guarding the nation's most treasured documents is a job entrusted to what is probably the world's safest safe. At night the safe automatically lowers cases containing the Declaration of Independence, the Constitution and the Bill of Rights into its own interior, locks mammoth doors. In its construction, the Mosler Safe Company depended on M&T Murex electrodes—products of METAL & THERMIT CORPORATION, General Offices: Rahway, New Jersey.

MUREX
PRODUCTS FOR BETTER WELDING

DOES YOUR WELDING EQUIPMENT REQUIRE WATER COOLING?



"Bernard" WATER COOLERS provide the most complete selection of cooler circulators for use on the following types of welding equipment, at prices from $92.00 to $325.00.



TIG | MIG (GUN) | AUTOMATIC | SPOT | INDUCTION

PROVIDES . . . A dependable trouble-free source of coolant for your welding equipment, in the shop or in the field.

ELIMINATES . . . Expensive plumbing, long hoses, etc.

PROTECTS . . . Equipment from burn-outs, clogging of nozzles, etc.

SELECTION . . . 9 Models to choose from.

PIONEER FOR **BERNARD** MODERN WELDING

Remember ! !

There is a Bernard Cooler to fill your cooling need.

Call your welding distributor or write today

BERNARD WELDING EQUIPMENT CO.

10232 Avenue N Chicago 17, Illinois

duced testing expenses . . .

Reciprocity of welding operator qualifications is another potential area for reducing testing and allowing consequent savings . . .

Before significant progress can be made in the above situations we must have more uniformity among the welding provisions of the welding codes . . . A consolidation of requirements of the welding sections of codes existing in this country . . . would be beneficial.

A possible objective would be a single welding code comprising sections devoted to various applications or industries and/or providing for variations peculiar only to specific applications. In conjunction with such a code various levels of service requirements and various levels of acceptability with respect to . . . inspection . . . would be established.

The level of acceptability and/or applicable sections of the general code would then be a matter of agreement between purchaser and supplier. In conjunction with this single general code would be provisions for welding operator qualification at various levels of proficiency. . . Operator qualifications could allow for movement between employers without requalifications. . .

It is agreed that many obstacles need to be overcome to establish uniformity, however, the end would be the elimination of countless duplications of tests to qualify processes, procedures and joint designs. It would also eliminate duplications of tests to qualify operators for each new contract or with each new employer. The savings to fabricators would be enormous and the final result would be lower-cost welding which would further its acceptance. These factors would ultimately reduce the amount of testing and the cost involved.

Howard B. Cary
Director
Hobart Bros. Technical School

"No thank you. I'll light my own."

World's best cars welded with M&T Murex ELECTRODES

More than one out of every four cars produced in the United States—the world's best—is welded with M&T Murex electrodes. For joining frames, or unitizing bodies, the people who build the best cars depend on the best welding materials—products of METAL & THERMIT CORPORATION, General Offices: Rahway, New Jersey.

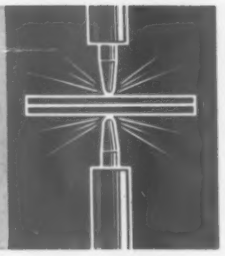
MUREX
PRODUCTS FOR BETTER WELDING

P. R. MALLORY & CO. INC.

MALLORY MEMOS

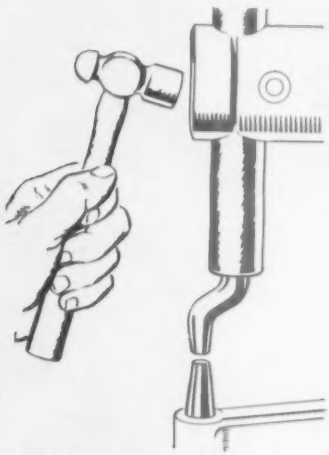
NEWS AND TIPS ON RESISTANCE WELDING

P. R. Mallory & Co. Inc., Indianapolis 6, Indiana



WELDING HINTS

Use enough cooling water . . . at least 1½ gallons per minute through each tip; pays off in longer tip life, stronger welds. (Mallory fluted hole electrodes give you extra cooling and extra life . . . without extra cost.)



Don't use a steel hammer to knock welder arms into alignment. Avoid damage by using a rawhide or rubber mallet.

Send for this handy wall chart of "Do's and Don'ts" for your shop.

Make 1001 Welding Set-ups with MALLORY Holder Components

One of the best time-savers you can have in your resistance welding tool crib is a kit of the new Mallory interchangeable holder components. In a matter of seconds, you can put together the holder you need for hundreds of set-ups that you may have considered special. Changeovers can be completed in minimum time by anyone who can handle a wrench. And the holder inventory you need is only a fraction of what you would otherwise need to carry.

Holders: ejector, or non-ejector; made of several high strength Mallory alloys.

Barrel: choose from four diameters, several standard lengths, and a number of tapers and threads.

Adapters: a variety of straight and angle designs increases flexibility of Mallory holders.

Ask your local Mallory welding distributor to show you how interchangeable holders can save you time and money. He'll be glad to help you select the components best suited for your shop.

Mallory welding products are available from authorized distributors located in all principal cities.

BETWEEN PASSES

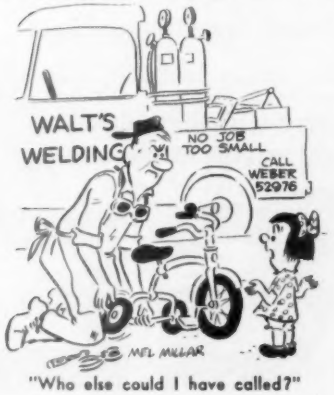
more promotion

Last month, *WE* reported how Hobart Brothers Co. promotes welding on its mailing envelopes. Another similar boost for welding is the suggestion, "Better your products thru welding," which is now metered all envelopes of County Welding Supplies Co., 1307 N. Adams St., Peoria, Ill. T. M. Corcoran writes, "Just to let you know we are trying to promote welding as you are. We have used this item (the metered slogan) since May, 1958, and hope it has done some good."

Undoubtedly it has.

underground

One of the more remarkable sights seen by Jim Alcock of Saginaw Welding Supply Co., Saginaw, Mich., on his recent European tour, he reports, was the underground oxygen production facilities of Svenska AB Gasaccumulator, better known as AGA. The gas producer's "rock workshop" is at Lidingo and houses one of Sweden's few liquid-oxygen plants. The first part of this subterranean site was completed in 1943, but the oxygen plant was not built until 1951, necessitating an expansion of the workshop. Total floor area at present is 34,000 sq ft, and more than 640,000 cu ft of granite were removed during construction. Internal walls and ceilings are of concrete or, as in some cases, of corrugated steel plate—all of which are painted white. The excellent illumination and the internal structure, combined with a ventilation system that changes the air about 7 times per hour, almost entirely eliminate the impression of being underground.



"Who else could I have called?"

music man

Lloyd Nesbitt, welding machine specialist for the Pittsburgh office of Metal & Thermit Corp., has wanted a pipe organ for a long time. Both he and his wife are accomplished organists, and he is a professional singer as well as a musician. Nesbitt purchased an old pneumatic organ from a local church several years ago. After dismantling it, he converted the instrument to an electric-pneumatic organ. To do so, he had to diagram, wire and solder thousands of separate electrical connections. Installation was another problem—solved only by an addition to the Nesbitt house—for full-range pipe organs are anything but small. Sound is brought into other portions of the home by an elaborate system of louvers in the walls.

This king-size do-it-yourself project has taken well over four years. Obviously a man of many talents, Nesbitt is an active member of the American Welding Society and is an authority on welding and welding equipment.

down under

The *Australian Welding Journal*, official publication of that country's Welding Institute, in a recent editorial suggests a national welded products month similar to the one in the United States. Originated by WELDING ENGINEER, and now sponsored in April by the American Welding Society, this country's welded products month has achieved sufficient recognition to prompt the editor of that distant journal to write:

"We . . . must strive to emulate the example of welding men in the U. S. in order to advance the frontiers of welding in this country."

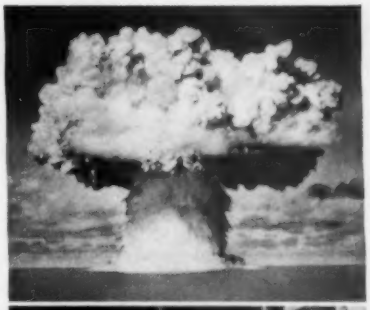
We wish our overseas colleagues success.

World's toughest ...safest ...best

You won't always find welds by M&T Murex electrodes in the world's toughest, safest or best equipment. But you'll surely find them in the world's most carefully manufactured.

Murex electrodes comprise one of the broadest lines of quality rods and wire. Choose from over 1000 types and sizes—mild steel and low alloy, stainless, hard surfacing, etc. Ask the M&T man or send for free literature. Also for information on M&T's complete line of welding machines. METAL & THERMIT CORPORATION, Rahway, N. J.

MUREX
PRODUCTS FOR BETTER WELDING



When you buy welding wire from PAGE,

you get— THE RIGHT WELDING WIRE,

• The only *sure* way to get a dependable weld—a non-porous weld, free from cracking—is to use a welding wire which will give weld metal compatible with the base metal, and which contains deoxidizers designed to eliminate all impurities.

PAGE has had more than 50 years of experience in the development of welding wires for specific jobs. As a result, you can get the wire best suited to your welding job—and you can get it from local stocks, packaged in the way that fits your own production requirements.

AUTOMATIC WELDING WIRE

A choice of 33 analyses of automatic welding wire enables you to get the *exact* wire you need for any welding operation. Here are some examples:

A-S-Armco • a pure iron for welding "Armco Iron," which contains other elements in a quantity guaranteed to be less than 0.1%.

A-S-6 • for welding mild steel with exceptional ductility—50,000 p.s.i. average tensile, with 35% elongation.

A-S-10 • a low-carbon mild steel, chiefly used for submerged arc welding.

A-S-15 • an aluminum-killed mild steel which gives a tensile strength of approximately 75,000 p.s.i. with 40% elongation.

A-S-16 • the same as A-S-15, but with molybdenum added for higher tensile strength.

A-S-17 • a modification of A-S-10 with silicon added for use with inert gas.

A-S-18 • the first successful wire for CO_2 welding of high-carbon and sulfur-bearing steels and for general use on low alloys.

A-S-20 • a high-tensile submerged arc rod, also suitable for CO_2 welding.

A-S-25 • a modification of A-S-20, with deoxidizing agents added for better CO_2 welding.

A-S-30 • produces porous-free weld metal, even on a very dirty steel. Contains up to .75% aluminum for maximum deoxidation.

A-S-65 • reasonably priced for hard-facing with high resistance to abrasion or erosion.

A-S-4130 • a medium carbon, chrome-molybdenum alloy for welding the SAE 4100 series of low alloys.

A-S-6150 • a low alloy hard-facing rod, producing a Rockwell hardness of C-32 which can be machined or ground.

A-S-8620 • contains chromium, nickel and molybdenum, and can be used with any low alloy containing any or all of these metals, even when the exact analysis is not known.

A-S-Stainless • several stainless wires are available to match the various grades of stainless steel.

METAL SPRAY WIRE

Metal spray wires generally deposit a coating of the same analysis as the wire employed, and this deposit may be built up to any thickness. The deposit is porous and has little tensile strength, but provides excellent anti-frictional characteristics and resistance to abrasive wear.

BARE and SULCOATED ELECTRODES

PAGE electrodes are available for use with Armco, mild steel, low alloy and heat-treatable steels, and for impact-resistance surfacing.

GAS WELDING RODS

PAGE gas welding rods are available in any of the analyses for welding wires. Any welding wire grades listed can be furnished in 36″ straight lengths for gas welding rods. Rods also can be furnished in coils and on reels.

PAGE—

WHEN YOU NEED IT, PACKAGED THE WAY YOU WANT

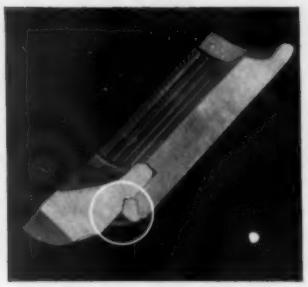
NATIONWIDE DISTRIBUTION and WAREHOUSING

PAGE welding wire, rods, and electrodes are as close as your phone. Prompt delivery is assured from a coast-to-coast network of PAGE distributors backed up by strategically located warehouses.

LET PAGE HELP YOU SOLVE YOUR WELDING PROBLEMS

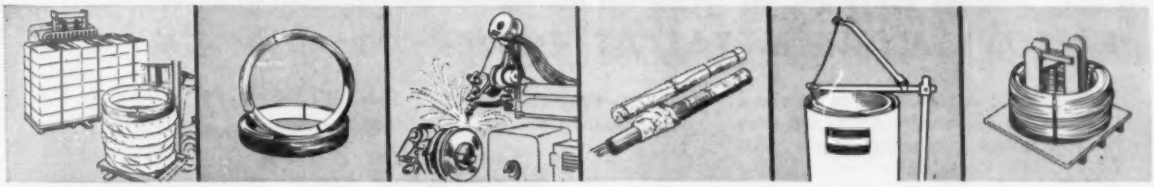
From our 33 analyses, we usually can prescribe the wire best suited to your requirements. We also can develop special wires when needed to solve a particularly tough welding problem. At all times, PAGE welding specialists are ready to give expert advice. Call on us for help.

Liner markings on each coil of PAGE welding wire provide positive identification, end mix-ups. And on #2 coils, liners are color-coded as well. The color of the stripe indicates the grade, makes identification double-quick and fool-proof.



Perfect weld of SAE 1141 to SAE 1151 was accomplished with A-S-18, using CO_2, to form an automotive drive shaft. Note clean metal in cutaway portion shown at left. There's no annealing of the high-carbon resulfurized steels, because preheat and post-heat are not required.

PACKAGING TO MEET YOUR REQUIREMENTS



25-lb. or 60-lb. coils, single or palletized—also in single or palletized individual cartons, or in waterproof reusable fiber-board drums.

120-lb. or 180-lb. coils, paper-and-burlap wrapped, or in palletized cartons. Special coil sizes on application.

25-lb. reels (spools) in cartons are designed to fit all standard machines; single or palletized to meet your requirements.

Gas welding rods in 50-lb. paper-and-burlap bundles; in fiber-board cartons of 10 lb.; and in boxes of 50 lb. or over.

Payoffpaks and Leverpaks are furnished with diameters ranging from 15" to 23" and capacities from 25 lb. to 700 lb.

Payoffpallets hold 900-1200 lb. of wire (sizes 3/16" to 3/8" incl.) coiled around pedestal on top of a wooden pallet.

...These Folders can help you...

Write for:

Folder DH-402-O • Contains information on submerged arc and inert gas automatic welding wire. Lists descriptions and uses of the many PAGE analyses. Describes our extensive variety of packaging.

Folder DH-1218 Chart lists detailed analyses of PAGE automatic welding wires, metal spray wires, bare electrodes and gas welding rods. Shows uses and properties. Lists most competitive makes.

PAGE WELDING WIRE

Page Steel and Wire Division • American Chain & Cable Company, Inc.

Monessen, Pa.*, Atlanta, Chicago*, Denver*, Detroit, Houston*, Los Angeles*, New York, Philadelphia*, Portland, Ore., San Francisco*, Bridgeport, Conn.

*Indicates PAGE warehouse stocks

ACCO

—the source for answers to wire problems

MANHATTAN PORTABLE WHEELS

REMOVE *MORE* METAL AT LOWER COST

Fast cutting action *plus* long wheel life add up to more output per man hour . . . lower production costs with Manhattan Portable Wheels. Every specification of the wheel you use—type of abrasive, grain size, hardness, structure and bond—is determined only after a careful analysis of your grinding problems . . . the amount of metal *you* want to remove, and the finish *you* require.

Workers prefer Manhattan Portable Wheels because they get more pieces done. Management prefers them because they assure faster, more uniform quality production . . . and they last longer.

Flared cup, depressed center, cone, plug and mounted point, or straight—there's a Manhattan Portable Wheel engineered for your job requirements. Ask about the new Safety-Back Flared Cup Wheel. Let a Manhattan representative show you how to remove *more* metal, *faster* . . . get "More Use Per Dollar" . . . with Manhattan Portable Wheels and other types of high speed, heavy duty abrasive wheels.

FASTER CUTTING ACTION

LONGER WHEEL LIFE

CUSTOM-MADE FOR YOUR JOB

RM949

GRINDING WHEEL INSTITUTE MEMBER

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RAYBESTOS-MANHATTAN, INC.

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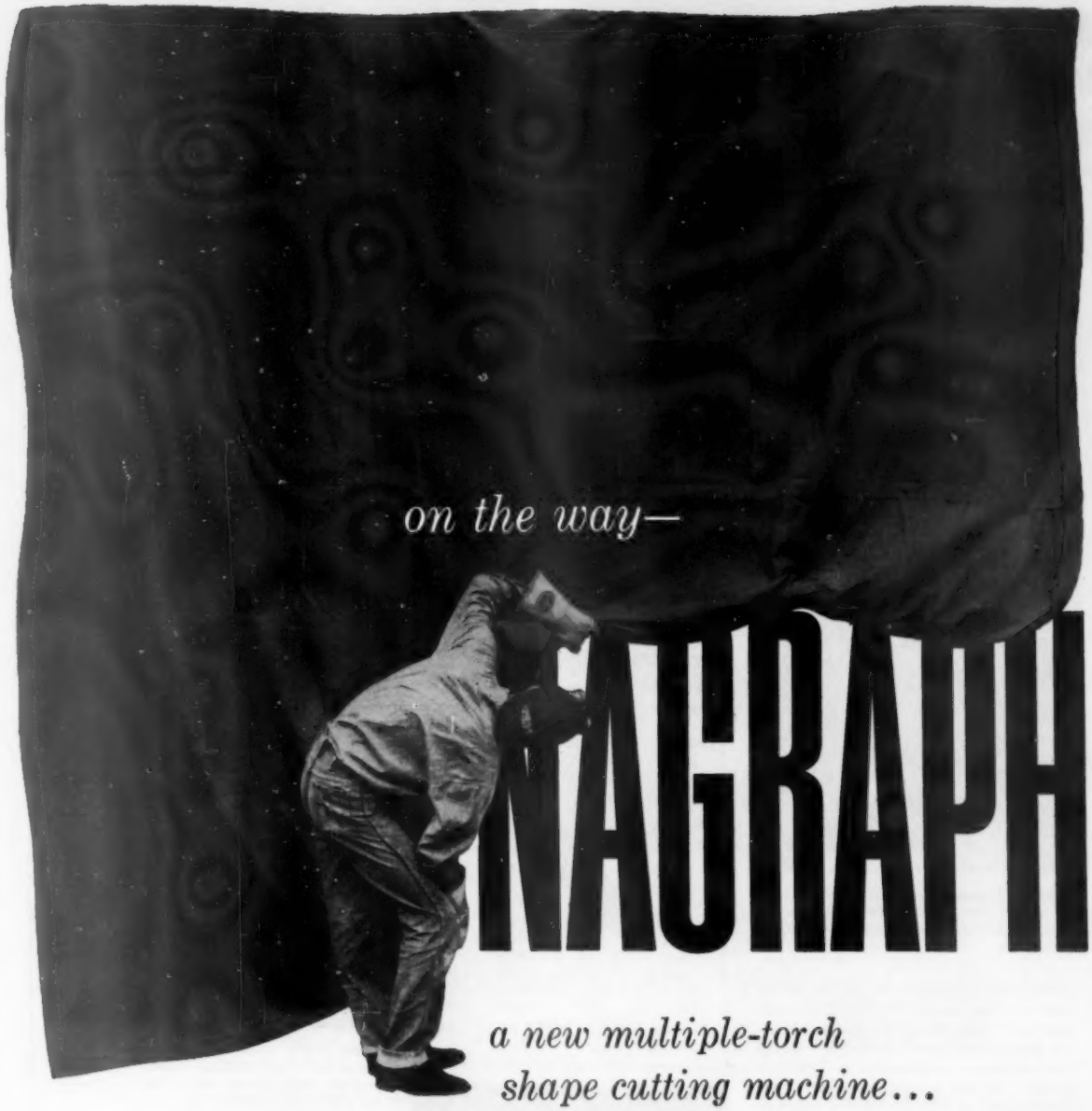

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Airco quality cuts,
faster operation, trims your costs

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Medium Frequency (1200 TO 12,000 CYCLES) Induction Heating Equipment for Stress Relieving

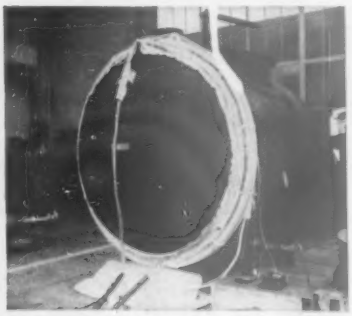
By Werner K. Haessler, Project Engineer, Brown Boveri Corp.

BROWN BOVERI

Brown Boveri manufactures turbine and generator shafts, precision marine gears and other products requiring flawless, stress-free weldments. After thorough testing, the Company adopted medium-frequency induction heating for stress relieving of weldments and for shrink fitting. Compact, mobile power-converters and special heat-resistant, insulated cable were developed . . . adding speed and flexibility to induction heating techniques. Standard sets are now available.

Advantages

Induction heating offers complete mobility not possible with furnaces. Even assembly welds at a customer's



Cable arrangement for stress relief treatment of welded flange. Diam. 80", thickness ⅝", max. temp. 1148°F. Maximum power: 60 kw at 2.4 kc/s.

plant can be heat-treated. It generates the heat *inside* the metal as compared to furnaces or resistance heaters that heat from the *outside* using high surface temperatures. Thermocouple control allows more accurate adherence to prescribed temperature gradients. Simple cable and insulation arrangements cut labor cost. Cables and work can be covered with asbestos blankets to minimize radiation losses.

Medium frequency induction heating allows the use of relatively short and light cables with longer cable life. Since only a few turns are required, the energy is concentrated at the welding area allowing substantial power savings. The medium frequency system is adaptable for workpieces from 1/32" thick up to heavy forgings. (Low frequency systems, 50 to

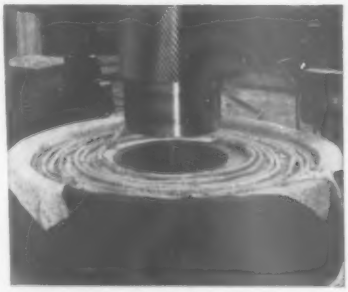
Mobile truck for 38 to 110 kw output units. Larger units are also on a mobile chassis. Automatic temperature sequence control. Graph shows record of complete sequence.

400 cycles, require thick or very long cables and are limited to heating thick, heavy sections.)

Brown Boveri medium frequency converter sets

Frequency kc/s	Power kw	Voltage v	Input* kva
1.2	60	360	90
1.2	110	630	155
1.2	165	720	230
1.2	220	900	300
2.4	50	400	72
2.4	66	540	95
2.4	88	720	127
2.4	130	720	190
2.4	185	900	260
4.8	38	600	60
4.8	55	800	83
4.8	77	540	115
12	44	650	65
12	66	450	95

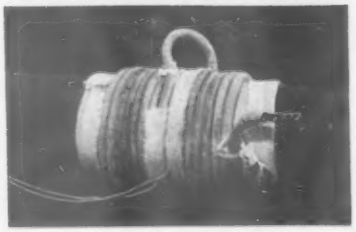
*3-phase motor input at 220, 440 or 500v, 60c.



Shrinking a gear wheel onto a shaft. The insulating blanket covering the cable has been removed to show the cable arrangement.

All sets are complete on a mobile, 4-wheel chassis. Plug and socket connections are supplied for connecting 2 similar sets in parallel for higher power. Drip-proof housing for outdoor exposure. Power and heat controls provide accurate, automatic heating, soaking and cooling periods with no supervision.

The complete range of Brown Boveri stress relieving units makes it possible to provide the frequency best suited for the specific size, thickness, composition and shape of the workpieces to be treated. In general, the lighter the workpiece, the higher the frequency. Experience has proved, however, that if one machine is to be used for a variety of applications, frequencies in the range of 2 to 2.5 kc are the most suitable.



Upper photo: Cable position during pre-heating at 850°F and welding. Below: Cable windings are simply pushed together and are ready for stress relief treatment up to 1250°F.

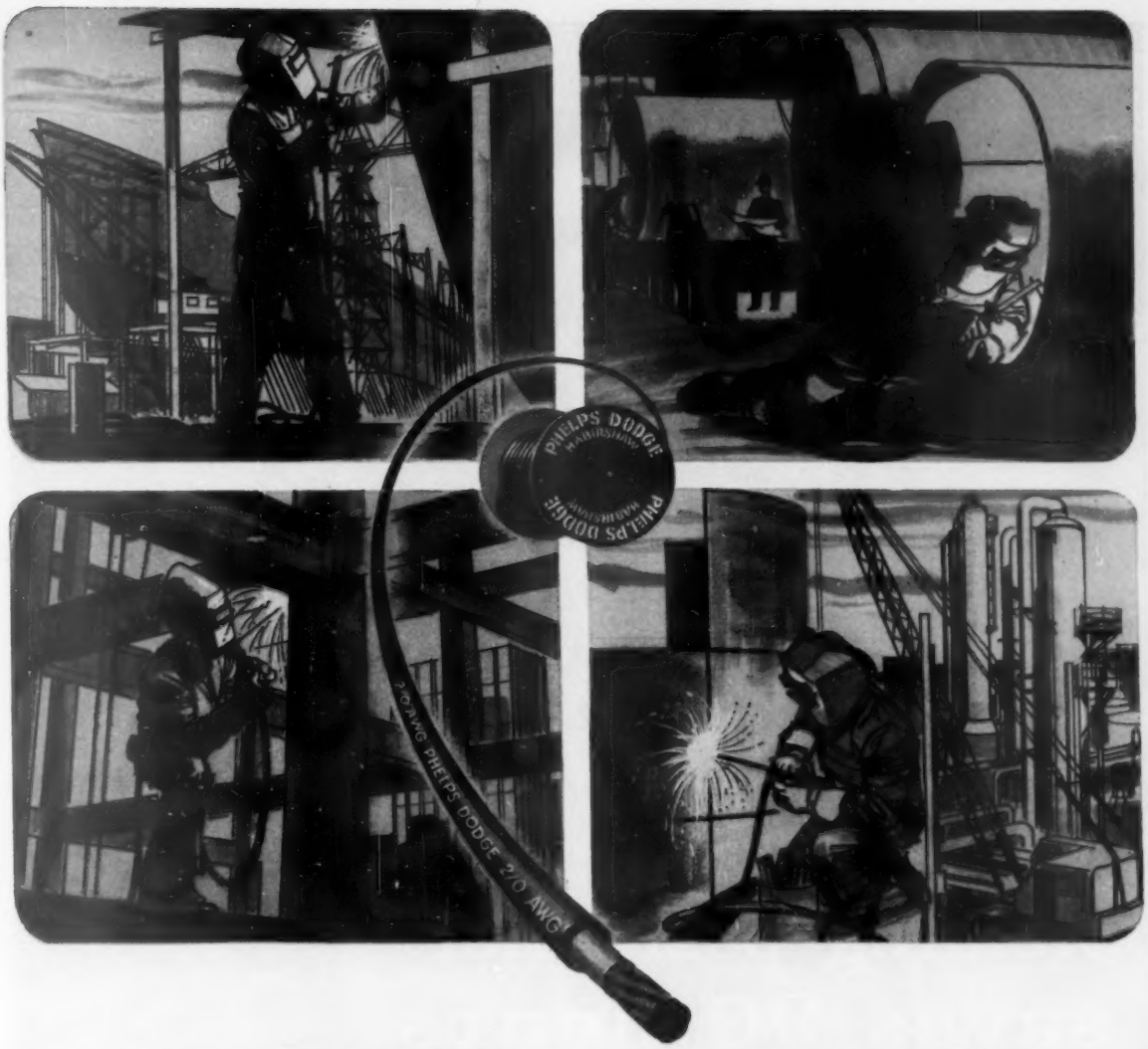
Brown Boveri Induction Cable

Highly flexible, heat-resistant. For work temperatures up to 1250°F without water cooling. Can be used for preheating then stress relieving without removal during welding. Bends to radii of 2" or less for easy application to the work. Supplied in easy-to-handle sections of 15 to 50 ft. quickly connected during application. Insulated for 1000v.

Write for complete details and Cost Estimate Questionnaire.

BROWN BOVERI

U. S. Sales and Engineering: Brown Boveri Corp., Dept WE10, 19 Rector Street, New York 6, N. Y. Agents in 27 U. S. cities.



Phelps Dodge Habirprene* Arc Welding Cable

lasts longer under roughest working conditions!

The durable quality of Phelps Dodge Habirprene arc welding cable makes it ideal for use on jobs where welding cable undergoes severe physical wear and tear. Records show that Habirprene cable more readily absorbs heavy blows and weights, resists oxidation and damage caused by severe working conditions in shipyards, oil refineries, building construction and boiler-making plants. In some applications, Habirprene cable has lasted many times longer than rubber cable.

More than 10 years ago, Phelps Dodge pioneered Habirprene welding cable—the first real advance in this field. Today's Habirprene welding cable is the result of Phelps Dodge development and manufacturing experience devoted over the years to providing an arc welding cable of superior quality with a proven record for safety, dependability and long life. This cable meets all requirements of A.S.T.M. D752.

See your authorized Phelps Dodge distributor for hard-wearing, long-lasting Habirprene arc welding cable with indelible gold markings. Phelps Dodge also makes a full line of rubber arc welding cable and welding power supply cable. All these cables are available from stock.

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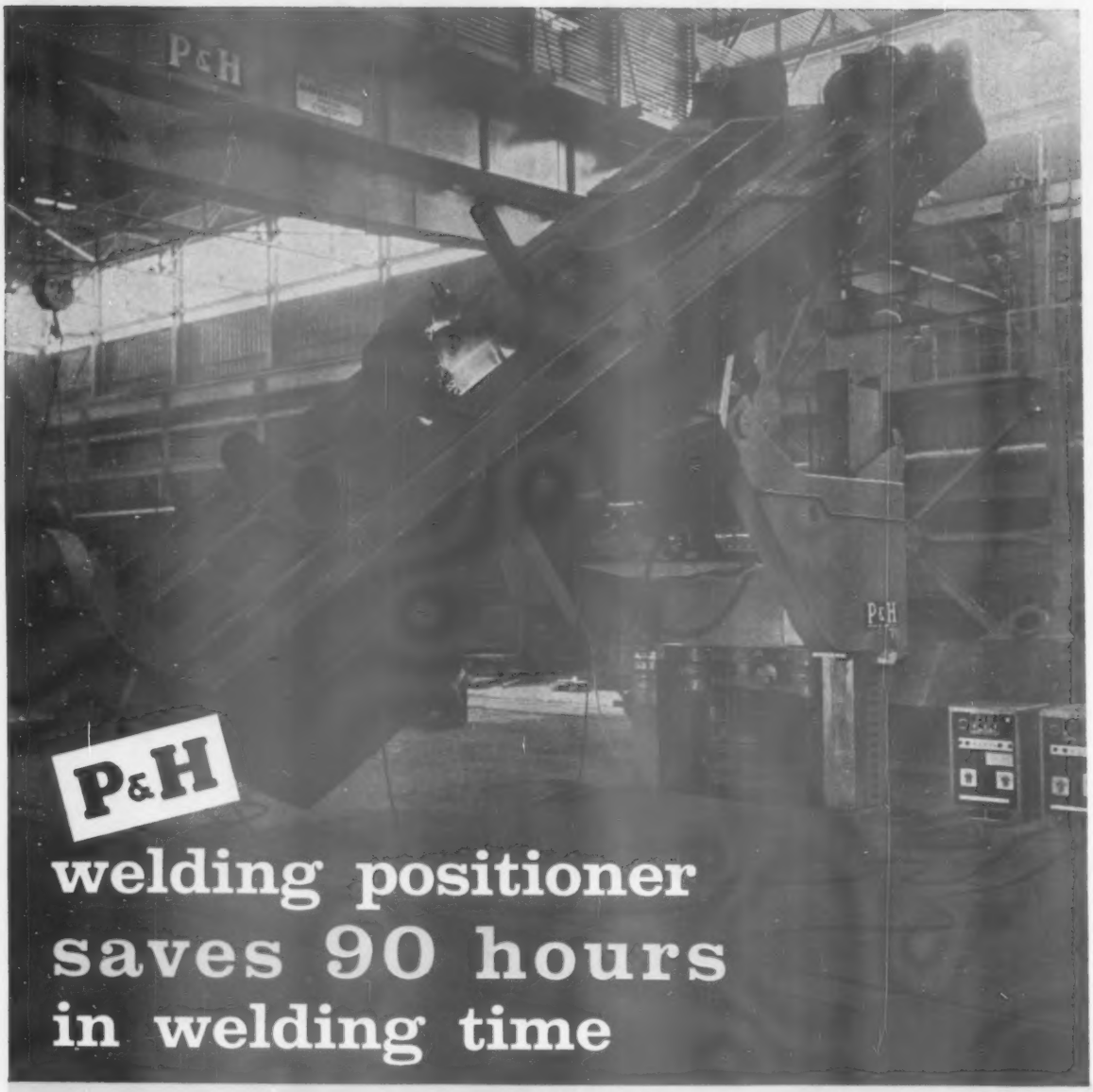

P&H welding positioner saves 90 hours in welding time

The P&H WP-80 — world's largest power-elevating positioner — is the only welding positioner made that can power-elevate 40-ton weldments.

Savings come big when you use P&H welding positioners in your welding operations. Here's proof — the results obtained by using a P&H WP-80 positioner in welding the power-shovel frame shown above:

The weldment is 12 ft. wide, 35 ft. long, 3½ ft. high, and weighs 59,000 lbs.

Downhand welding permitted depositing much heavier first-run beads, thus eliminating stringer beads. The number of passes in most cases dropped from three to one. The result: *a cut of 90 hours in welding time alone!* And the number of crane lifts was slashed from 32 to 9.

With the WP-80, work interruptions dropped sharply — safety was greatly improved. That's because, once the piece is secured on the positioner, the operator can position it at any angle quickly and easily by remote control.

P&H offers you a complete line of welding positioners in capacities from 500 to 100,000 lbs. — with variable speed, if you desire. For more facts, get a copy of "What you should know about welding positioners." Write to Dept. 309C, Harnischfeger Corporation, Milwaukee 46, Wisconsin.

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OCTOBER, 1959

Welding Engineer

ESTABLISHED 1916

The "waste" land

THE LOSSES RESULTING from the current steel strike can be calculated in millions—millions of tons of steel; millions of dollars in workers' wages, and millions more in government taxes.

We in welding are confronted with a condition similar to the steel strike. And if it were possible to make the general public as aware of the "welding strike" as it is of the current steel strike, something might conceivably be done to correct these deplorable conditions.

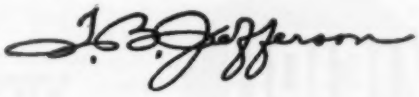
Actually, there is no welding strike as such—*but all of us are being penalized as if there were.* It can be safely said that millions of tons of steel, as well as thousands of tons of other materials, are being lost—*wasted*—because architects, engineers and designers refuse to take advantage of the 16 to 33% saving afforded them by intelligent use of welded construction.

Not only does this refusal waste our resources needlessly, but in times like these, helps contribute to inflation and any possible steel shortages due to the strike.

Then there is the problem of wasted manpower. If there were an over-abundance of riveters, the insistence on antiquated joining methods might be understandable. *But this isn't the case!* Throughout the country there is a lack of skilled craftsmen in every trade. So why aren't we conserving our manpower?

This continued, extravagant use of materials and manpower can lead only to economic destruction. Of course, there will probably be more important factors contributing to this destruction than just the lack of welding use. However, our concern is welding.

We know its use will help curtail these evils—and as men of welding, we should do something about it. We can help conserve national resources, reduce manpower demands, fight inflation—and at the same time, increase the use and growth of welding.



This roller, hardfaced with Victoralloy, shows practically no wear after crushing 40 tons of rock hourly, 8 hours daily for 30 days.

HOW TO SAVE ON ROLLERS AND ROD

....*Use VICTOR Hardfacing*

Tracy Rock & Gravel Co., Tracy, Calif., crushes 40 tons of rock hourly, prolongs roller life on this rough work by rebuilding with ¼" VICTORALLOY #1 Bare Electric rod, 28" length. Says plant superintendent Albert Parker:

> "Victoralloy's ease of application and fast buildup mean a lot to us. There is no lost time as we use 28" length rod; when it burns down, we touch a new rod to the old one, and keep on welding without even lifting the helmet."

You, too, can save rod and increase working life of crusher rolls, screens, shovel teeth, tractor rollers and idlers, dredge pumps and many other parts subjected to abrasion and severe impact. Simply hardface with VICTORALLOY. It welds to manganese, steel or cast iron. You get all position hardfacing, exceptional arc stability, deposits free of porosity, fast application without slag interference. Try it. Order a supply from your VICTOR dealer TODAY.

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Welding
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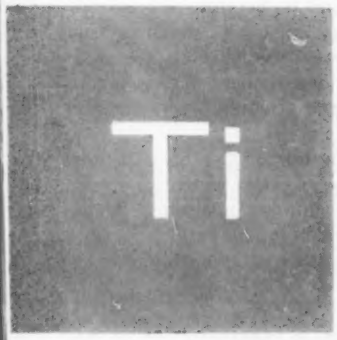
Welding the reactive metals



LABORATORY CURIOSITIES—this was the description given to many of today's nuclear-age metals when first considered in their pure form. Recent years, however, have seen commercial application of these metals.

Among them, titanium, zirconium and tantalum are becoming best-known for their unique characteristics—high corrosion resistance, good physical properties—making them the modern engineer's dream-come-true.

Manufacture and fabrication, however, are not without difficulties.

Stringent precautions must be applied to avoid embrittlement by absorption of oxygen, nitrogen or hydrogen at elevated temperatures. Thus, the initial production of the metal and any subsequent hot working, welding or brazing must be performed under an inert atmosphere with complete freedom from grease and any other foreign materials.

The resulting increase in production costs is outweighed by these metals' ability to give satisfactory service in applications where more common metals would not be useable. It must be stressed that economic use of titanium, zirconium and tantalum (or any of the other newer, expensive metals) depends on careful design fabrication to use fully their special properties and to utilize a minimum quantity of material, consistent with strength requirements.

Since prevention of embrittlement is the prime consideration when fusion welding these three reactive metals, conventional oxyacetylene and metal-arc welding processes are unsuitable.

Welding is complicated by the need to protect not only the molten weld pool, but all parts of the component being welded as well. Thus, it is necessary to create an inert-gas shield which will give greater-than-normal coverage.

Any grease or oxidation products on sheet surfaces prior to welding will provide another source of contamination. Mechanical cleaning methods and normal degreasing treatment should be carried out, but care must be exercised in using chemical reagents since they form explosive compounds.

Techniques have been developed using the Tig process for welding titanium in specially designed jigs and utilizing gas shields with auxiliary protective

AT the DeHavilland Aircraft Co., Ltd., a complete argon welding cabinet or chamber is used when fabricating the many complex aircraft parts which would be impossible to make on jigs.

coverage. As an alternative, chambers filled with argon may be employed if size and number of components permit economic operation of this system. (In general, these techniques apply equally to zirconium, tantalum.)

For Tig "open air" welding, jigs which provide maximum chilling adjacent to the weld to restrict the heat-affected zone are needed. These jigs may be water-cooled to assist in rapid heat dissipation and should incorporate an efficient gas shield to protect weld underside. Special shields have been developed using a trailing gas coverage, fed from an auxiliary supply.

Where quantity production is required, welding in a complete argon atmosphere may be desirable. In particular, complex-shaped components can thus be welded when it would be otherwise impossible to make jigs of the required size and shape.

The most common cabinet is a cylindrical vessel having removable plates for loading and for access to the weldor's rubber gloves extending inside. Construction of such a vessel requires ability to withstand vacuums in the order of 10^{-4} mm of mercury.

As an alternative to a steel vessel, rigid or flexible plastic containers have been used successfully and often provide easy completion of a limited number of components.

[*The electron beam vacuum welding process also provides contamination-free welds. Still another method, "motor-arc modification of the Tig welding method," has been successful in closing small containers, as reported by C. C. Stone, Argonne National Laboratory, at the annual AEC Welding Forum. In this latter method, the arc is moved around the tungsten electrode by arc current and a special magnetic field, rather than mechanically as in normal Tig welding.*]

While normal design procedures for Tig welding can be followed, preference should be given those avoiding

by **L. M. Gourd** and **F. W. Copleston***

use of filler wire, to reduce possible contamination from wire surface impurities. When using filler wire in the open-air technique, the heated wire must not be withdrawn from the protective argon shield.

Thus, flanged butt, edge and corner welds are preferred since these can be made without addition of filler.

Tig spot welding may be used for joints in lighter gages and below, but it will be necessary to have as adequate an argon protection as in manual Tig welding. Although Mig welding cannot be used now for fabrication of these metals in England, it is used in production of electrode for refinement of sponge titanium.

Titanium has found its widest application in the aircraft industry, where its high cost is balanced by a satisfactory strength-to-weight ratio and good corrosion resistance. The latter property is being exploited in the chemical industry, and there is much interest in the possibility of lining mild steel vessels with titanium. This, however, depends on development of a suitable technique for joining the two.

[*A diffusion layer between zirconium and stainless steel produced corrosion resistant, brittle-free bonded joints, according to K. H. Koopman of Knolls Atomic Power Laboratory. Both metals were first machined to an interference fit; mating parts were cleaned, forced together and heated to 1,800 F under high vacuum for the diffusion bond.*]

Zirconium also has very good corrosion resistance, and in addition, has a low neutron absorption cross section. Thus, its main use has been in construction of components for nuclear reactors. When high strength is required, zirconium can be alloyed with tin, iron, chromium or nickel without impairing the properties exhibited by the pure metal.

Tantalum has excellent corrosion resistance to most of the common acids, including concentrated hydrochloric and sulphuric acids, and is therefore very useful in the chemical industry. Like zirconium, tantalum has good resistance to body acids and both metals are used in surgical work, either for instruments or for bone-splints and other metallic objects remaining permanently in the body.

Thus, these three reactive metals offer a combination of properties which enable the engineer to design structures not practical with conventional materials. Problems in manufacture and fabrication still exist, however, and rapid solution of these with cost reduction should promote more extensive use.

In view of the abundance of titanium oxide in the earth's crust, it is reasonable to suppose that, given an economic method of extraction, there should be no titanium shortage in the future. Considerable advances can also be expected in production of special alloys of titanium, zirconium and tantalum. The number of firms concerned with their fabrication increases yearly.

[*For one company's solution to the high-cost problem, see* Electrolytic process promises less costly titanium, *p. 49.*]

*Messrs. Gourd and Copleston are with the Sales Technical Service Dept. of British Oxygen Gases Ltd., Cricklewood, London.

Welding Engineer **a special report**

Argon will be more plentiful, cheaper, WE survey shows

LAST MONTH, Southern Oxygen Co. announced to the industry that it would increase its argon output by more than three million cubic feet per month as a result of an agreement with Spencer Chemical Co.

This was good news to users of the atmospheric element because it was another indication of the trend to abundance, which in turn brings a promise of lower costs.

WELDING ENGINEER's Research Dept. surveyed the leading producers of argon (see box), and all agreed that the future will see a decrease in the price of this valuable inert gas. Present prices range from 8 cents per cubic foot to 13 cents, depending upon volume purchased. One supplier quoted a 5 cents-per price for bulk liquid argon.

In compiling its annual statistics WELDING ENGINEER has not broken down argon usage, but the leading suppliers tell us that last year, for example, approximately 75% of the 373 million cubic feet produced was diverted to applications in the welding and cutting industry.

(Just about 20 years ago, the only use for argon was in the incandescent light bulb.)

The anticipated reduction in cost of this important shielding gas has prompted many predictions of its even greater use in Tig (tungsten inert-gas) and Mig (metal inert-gas) welding.

Respondents to the *WE* survey ranged far and wide in their guesses, with two suppliers expecting a 50% increase in the argon used with these processes over the next five years, while another optimistically predicted a whopping 200% hike. Several other producers refused to hazard an opinion on the size of the boost, although all agreed that the use of Tig and Mig with argon would indeed increase.

It is expected that argon will find correspondingly greater application outside welding. Some of these, as listed by our respondents, include its use in metal flushing, protective atmospheres for melting, and in plasma-arc torches. But one independent producer commented that ". . . lower prices and better distribution will do more to promote the use of argon than finding new applications."

In its application as a shielding gas, argon faces its greatest threat from carbon dioxide. Not that the latter met with explosive success when the various CO_2 processes were introduced, but recent refinements, lending to its greater effectiveness on thin gages of mild steel, presage a substitution for argon in some applications. Also, there seems to be a move by carbon-dioxide proponents to invade the non-ferrous field—especially aluminum.

In both instances, cost is the dominating factor. Carbon dioxide generally costs only about 1 to 2 cents per cubic foot.

On the other hand, the *WE* survey indicates that many producers expect a counter-attack by argon to gain it as much as it might lose in the mild-steel field, especially in joining of gage thicknesses. This was revealed by their answers to the question, "To what extent do you feel Tig and Mig methods will replace manual and automatic arc welding processes?"

The automotive and aircraft industries (the latter including missiles and rockets) are seen as the two industries which will experience the greatest advances in welding with an argon shield.

One major producer noted that the production of the "wonder" metals, titanium and zirconium, is totally dependent upon an inert gas, thus will contribute to its increased use. *(See "Eliminating contamination is a prime consideration when welding titanium" and "How to weld zirconium and its alloys" on pages 46 and 50.)*

As important as argon is in shielding, producers say its advantages are fortified when oxygen or helium is added. These commercial mixtures have been put to great use by fabricators. Copper and copper alloys, for example, are best welded in a shield provided by an argon-helium mixture, while argon-oxygen combinations are best for carbon and stainless steels.

One major producer reports that an argon-hydrogen mixture has found a place in Tig welding of stainless.

No doubt about it, four major producers and four independents agree the argon picture is rosy. One of the latter quoted the senior Mr. Messer of Germany, who reportedly once said "The oxygen business in the future would be known as the argon business."

A startling statement in view of the large tonnages of oxygen required to take off even a small amount of argon (oxygen comprises 20.95% of our atmospheric air, argon less than 1%)—and what that means to the oxygen market is left for speculation.

Who WE asked

This report on argon is based on answers submitted by four major producers: Linde Co., Air Reduction Sales Co., Liquid Carbonic Div., General Dynamics Corp., and National Cylinder Gas Div., Chemetron Corp.; and four independent gas manufacturers: The Burdett Oxygen Co., California Oxygen Co., Houston Oxygen Co., and Pacific Oxygen Co.

Eliminating contamination is a prime consideration when welding titanium

by **T. M. Laurenson**
Pennsalt Chemicals Corp.
Wyandotte, Michigan

HOT TITANIUM, plus air, moisture, dirt, etc., equals contamination.

Although simple, this equation is at the heart of the most basic consideration of titanium welding—elimination of contamination. And it is equally applicable when welding any of the other reactive metals.

In many respects, titanium welding procedures are similar to those used for many other structural metals. However, its high chemical activity and sensitivity to embrittlement impose limitations and require special welding procedures.

During the past few years considerable effort has been expended to develop satisfactory techniques for fusion welding titanium. Tig welding has become generally accepted as the standard procedure to use.

[*Ed. note*: According to a recent translation of "Automaticheskaya Svarka," the electroslag welding method has been adapted for titanium welding. Developed by the Ukrainian Electric Welding Institute for welding steel, the process is now used for joining heavy sections of titanium. An electric current passes through a layer of conductive oxygen-free flux, generating heat to melt the filler electrodes. Pure argon is the most effective gas shield above the molten slag.]

Joint designs for titanium are about the same as those used for other metals. With the Tig process, butt welds may be made with or without filler rod, depending on the thickness of the joint and fitup. If fitup is good, filler rod is not required; if poor, filler metal is added to obtain full-thickness joints.

When welding material up to 0.062-in. thick, good welds can be made with no filler metal using a square-butt joint with tight fitup. If a thicker material is welded (up to about 0.125 in.), square-butt joints with clearance of ½ to 1 times the base metal thickness is recommended. Filler rod may be used.

When a single-vee butt joint and filler material are used in thicknesses above 0.250 in., the first pass should be made without filler, and the fusion zone should be kept to about one-half the plate thickness. The second pass is then made with filler in the conventional way.

Machining or filing is the preferred method of edge preparation. Any grinding should be eliminated if possible since the resulting elevated temperature could cause surface contamination. If grinding is a practical necessity, the ground-edge temperature should be kept well below 800 F. After grinding, thoroughly wire-brush all surfaces, or polish them with 180 Grit paper to remove any grinder-deposited foreign matter.

Because of molten titanium's extreme chemical reactivity (any dirt, grease, oxides, etc. will react at welding temperatures), thorough cleaning of joints and filler material before welding is very important.

For scale-free material, a simple degreasing operation is sufficient to remove dirt and oil, and should be followed by light wire-brushing. For materials with large amounts of light oxide-scale, acid pickling treatments are generally used. Most solutions contain nitric and hydrofluoric acids in concentrations of 10-47% and 2-4% respectively.

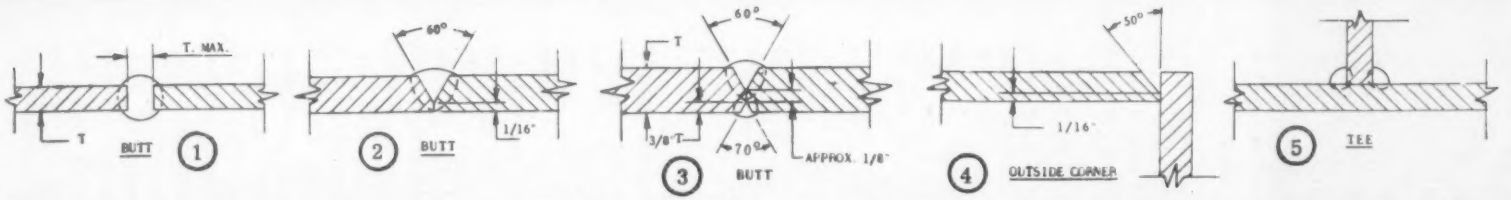
To minimize hydrogen pickup, however, the nitric acid concentration should be greater than 20%. Pickling times range from 1 to 20 minutes and bath temperatures from 80 to 160 F. After pickling, surfaces are rinsed with hot water and dried.

But the most effective and practical titanium cleaning method is a good, thorough wire-brushing. A clean, stainless steel brush is preferred. A new, clean steel brush is adequate if surfaces are wiped free of any brush-deposited rust. Sand-

The reactive metals will be subjects of discussion at the 41st National Metal Exposition and Congress sponsored by the American Society for Metals in Chicago, Nov. 2-6.

Papers will be presented during the technical sessions at the Hotel Sherman. On Monday, Nov. 2, at 9 a.m., titanium and its alloys will be discussed; topics range from the effects of hydrogen on mechanical properties to corrosion behavior of titanium-palladium alloy. Zirconium and its alloys will be discussed at the 9 a.m. session on Thursday, Nov. 5.

Manual welding of titanium



TITANIUM may be welded with efficiencies of 100% by arc welding techniques, which in many respects are similar to those used for other metals.

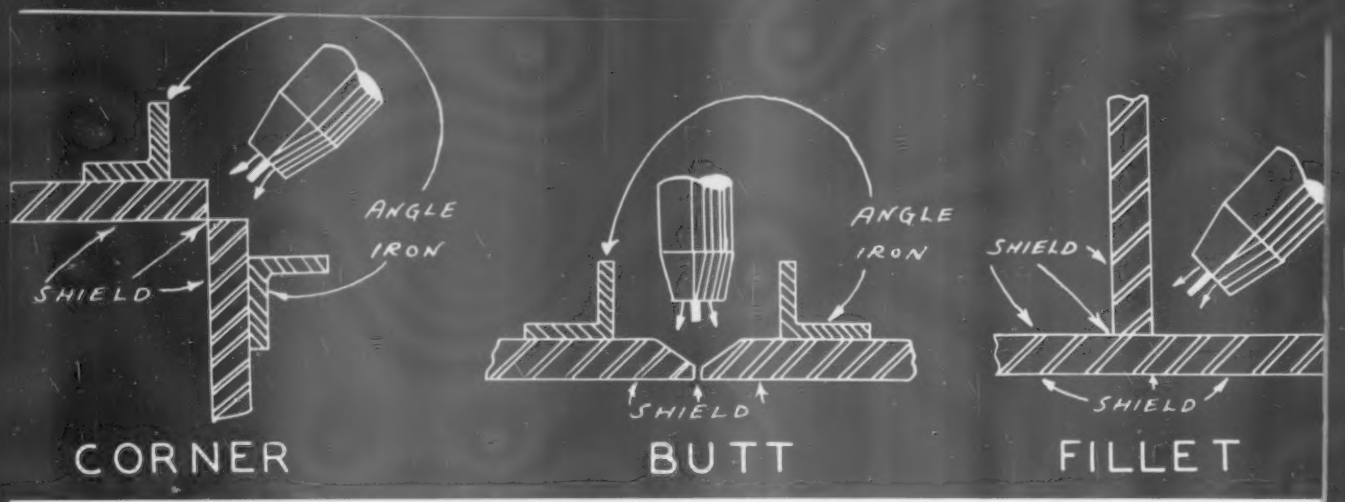
Titanium does present one extremely difficult welding problem. Molten and hot titanium must be protected from air and foreign materials. Relatively small amounts of certain impurities, particularly oxygen and nitrogen, will cause severe embrittlement of titanium and its alloys. Accordingly the molten weld metal in the heat-affected zones must be shielded from contaminating elements by a protective blanket of inert gases during welding. Coated electrodes or flux must not be used during any titanium welding operation.

Because of these limitations, titanium may be welded only by one of the inert-gas shielded methods. It may be welded readily by the Tig process, with or without filler metal. The ideal conditions are provided by inert-gas filled welding chambers.

Open air welding of titanium is possible, but the base metal should be properly shielded using a backup bar. Backup bars are highly desirable and backup shielding is a must. It is also desirable to use a trailing flow of inert gas to protect the cooling weld deposit.

Thickness inches	Type of Weld	Welding Current Amperes*		Tungsten Electrode Diam	Welding Speed ipm	Welding Rod Diam	Argon Flow† CFH		Remarks
							Nozzle	Backup	
1/16"	1,2 Butt	Direct Current -- Straight Polarity	90-110	1/16	10	None	15	5	One pass
	5 Fillet		110-150	1/16	8	None	15	5	" "
1/8"	1,2 Butt		190-220	3/32	9	1/16	15	5	One pass
	5 Fillet		210-250	3/32	7	1/16	15	5	" "
3/16"	2,3 Butt		220-250	3/32		1/8**	20	5	Two passes
	4 Corner		240-280	3/32		1/8**	20	5	" "
	5 Fillet		240-280	3/32		1/8	20	5	" "
1/4"	2,3 Butt		275-310	1/8		1/8**	30	5	" "
	4 Corner		290-340	1/8		1/8	30	5	" "
	5 Fillet		290-340	1/8		1/8	30	5	" "
3/8"	2 Butt		300-350	1/8		1/8**	40	5	" "
	3 Butt		300-350	1/8		1/16	40	5	" "
1/2"	3 Butt		350-450	1/8		1/8**	40	5	" "

*Without backup or chill bar, decrease current 20%. Also a backup gas is recommended at all times.
**No filler metal on the first pass.
†Trailing gas shield of equal flow required. Without trailing gas, increase flow 60 to 100%.



CHAMBER-like conditions have been obtained by use of baffles to confine the inert shielding gas. *Rem-Cru Titanium, Inc.*

blasting is recommended for any heavy or difficult-to-remove scale.

Since titanium has the unusual property of dissolving even its own oxide, all cleaning should be done just prior to welding, including a distance of about 10 times the base metal thickness from the weld joint. Surfaces should be antiseptically clean; even a finger-print smudge may cause some weld embrittlement.

From the above, it can be seen that adequate inert-gas shielding is the key-note to successful titanium welding. Whenever the hot metal (above 800 F) comes in contact with air, contamination occurs. Therefore, shielding must be considered from all directions.

For practical titanium welding, each job constitutes a specific problem, particularly the need for devising proper back-up shields. A typical welding setup would include:

(1) **Torch nozzle**—Metal nozzles are preferred to ceramic. The latter has been used successfully but may be a source of absorbed moisture and contaminated gases. Largest available nozzle should be used.

(2) **Trailing cup**—A trailing cup is simply a rear extension of the nozzle. Copper is the preferred metal, although aluminum or galvanized sheet iron would suffice.

The need for and the size of a trailing cup is mostly determined by base metal thickness (amount of heat) and welding speed. In many cases, if base metal is thin (below about 3/32 in.), the fitup is good, welding speed is slow and heat low, then the trailing cup can be eliminated.

On the other hand, if the base material is quite thick (above about ½ in.) and the heat is high, the trailing cup may have to be quite long (about 5 in.). In this case, it may even be necessary to insert an additional supply of inert gas in the trailing shield to afford complete gas coverage.

An optimum size cup adequate for most jobs would be about 2-in. long and 1-in. wide. The inert gas supplied by the torch would be ample to accommodate a cup of this size.

(3) **Back-up bar**—The purpose of the back-up bar is to supply gas shielding to the back side of the weld, and to help conduct heat away from the weld zone. It consists of a piece of bar copper about ½-in. thick, 4-in. wide with length determined by the job. A groove 3/16-in. deep by ½-in. wide is cut down the center.

A header is attached to the opposite side paralleling this groove. Holes about 1/16-in. diameter (3 in. apart and staggered from the centerline) are then drilled in the groove bottom into the header. The bar is clamped to the back side of the joint to be welded.

(4) **Chill bars**—These bars or hold-downs serve as heat conductors, shielding baffles and help to hold work in place. They can be of steel ½-in. thick, 2-in. wide with length determined by the job, and beveled longitudinally on one edge to an angle of about 30 deg.

Two are required and are clamped to the work and back-up bar, one on each side of the weld with the bevel facing the weld. They should be spaced so that there is ample room for the torch, but no more.

(5) **Inert gas**—Only argon or helium of the highest grade purity should be used, and the gas dew point should not be higher than —60 F. All parts of the gas distribution system should be tight, clean, dry.

Helium has the advantage of producing a more intense arc which tends to promote better penetration and minimize porosity. In general, however, argon is the preferred gas because of its high density and better shielding effectiveness.

Mixtures of 25% argon, 75% helium have also been used, combining the best features of both gases. Whichever gas is used, the same should be used for back-up shielding to maintain uniform arc characteristics.

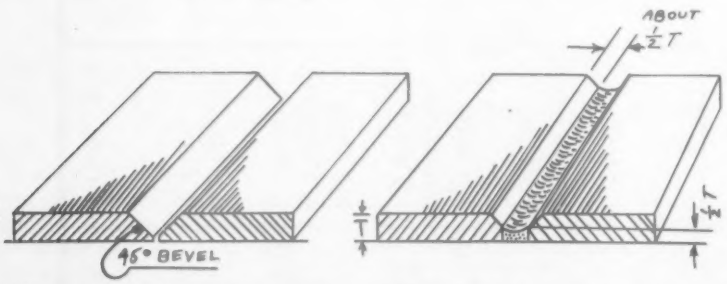
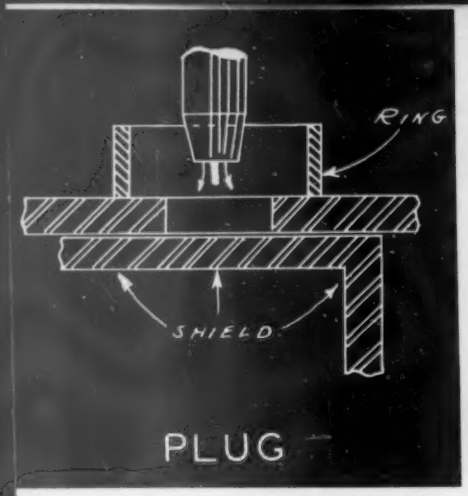


PLATE preparation when welding titanium using filler material is shown above, left. However, when plate is thicker than 0.250 in., the first pass should be made without filler (above, right). Filler is then used in the conventional manner.



Exact gas flow rate is difficult to specify. However, visual weld inspection can determine if shielding is adequate. A flow rate of 20 cfh of argon will probably be suitable for most jobs and is a good starting point. If helium is used, start with 40 cfh since twice as much is required to effect the same coverage as argon.

Back-up flow should be low enough so as to eliminate high back-up pressure, which can result in blow-through or a recessed weld.

A simple field test to determine if gas protection is adequate is to hold the torch stationary over a bead, allowing the molten metal to cool under the gas blanket. Any discoloration is an indication of insufficient coverage or poor gas distribution.

(6) **Welding chambers**—Where complex joints and small parts are to be welded and special fixtures and baffles are expensive and impractical, a welding chamber is used. This is merely a box of suitable size (aluminum is a good material) that can hold the work and welding torch and be purged with an inert gas. Welding is done by means of rubber gloves attached to the chamber sides.

After purging and before welding, a scrap titanium piece should be welded to burn up any residual oxygen. Semichamber methods have also been used by providing baffles to confine the shielding gas.

Whenever possible, welding should be done without filler material, since hot filler metal is a prime source of contamination. If a filler rod is used, the hot tip must be shielded at all times, and if contamination is suspected, that section must be cut off and discarded.

Machine settings should be set as low as possible to produce 100% penetration welds. As a guide: 25 amp should suffice for 0.040-in. titanium, and about 170 amp for 0.093 in.

Using d-c straight polarity, the torch should be as close to perpendicular as possible. Welding speeds will, of course, vary with base metal thickness, but 3 ipm is recommended as a minimum.

Starting and stopping the arc should be done with a foot control unit. This will avoid burn through, since lower amperage can be used when starting and stopping, and will also allow the torch to be held in place until the weld has cooled.

If a foot control unit is not available, starting and finishing tabs should be used to take up the burning and contamination.

In commercially pure grades of titanium where absolutely no contamination has occurred, the weld bend properties should be practically as good as those of the base metal. Bend hardness and parent metal hardness should be similar and joint efficiencies can be 100% or better.

A bend test of a sheet metal fusion weld is an excellent indication of its ductility. An accepted bend for titanium is 105 deg over a 2T radius.

Good ductility and the color of the weld are functions of proper shielding. Therefore, weld quality might possibly be determined by its color, but only if the colors are very distinguishable.

For example, if the surface of the weld is a metallic silver color, shielding was excellent and the weld has good ductility. A light straw color ranging to a light blue color indicates the weld was not protected at low temperature, but ductility is probably good.

On the other hand, if the weld color ranges from dark straw to dark blue, the weld was not adequately shielded and poor ductility is the result. Should the weld be dark blue, gray or yellowish, or if deposits have little or no luster, then the shielding was extremely poor and the welds are very brittle.

Better and simpler methods of welding titanium will undoubtedly be developed as time passes. But for the present, as mentioned above, the key-note to successful titanium welding is adequate gas shielding.

Electrolysis promises less costly titanium

SOME OF THE SO-CALLED rare metals are rare only because of difficulty in producing them in pure form, *e.g.*, titanium.

Strong as steel and half as heavy, titanium is the fourth most plentiful metal found on earth. Yet because of difficulties in removing it from its ore, titanium metal has been commercially available only for the past 10 years.

Production is low (only 4,500 tons in 1958) and the present price is about $9 a pound in bar and sheet stock.

Norton Co. researchers have been working on the problem for 7 years, and according to the Worcester, Mass., firm, their newly developed electrolytic process promises less-expensive-to-produce titanium.

During electrolysis, titanium is separated from titanium carbide in the form of tiny crystals of pure titanium. These, when washed to remove the electrolyte, can be melted into ingots for use as a metal or fabricated by powder metallurgy techniques. The crystals can be used with any present day techniques.

Although cost estimates for actual production equipment are still to be formulated, the researchers feel titanium could be produced economically. One reason is the relatively inexpensive titanium carbide, which is commercially available and contains 80% titanium.

Present processes use titanium tetra-chloride, and although the per pound price is the same as titanium carbide, the latter contains about three times more titanium.

The Norton electrolytic process is also designed to produce columbium, vanadium, chromium, zirconium, tantalum, hafnium, molybdenum, thorium and tungsten.

WELDING THE REACTIVE METALS

Zr

by **L. E. Stark**
Mallory-Sharon Metals Corp.
Niles, Ohio

FIG. 1—Laboratory arrangement for straight seam welding of zirconium using the Tig process.

How to weld zirconium and its alloys

NUCLEAR PROPERTIES, corrosion resistance and mechanical properties—an optimum combination of these characteristics make zirconium and its alloys desirable for use in nuclear reactors and in many commercial applications.

And to retain these desirable properties, fabrication by arc welding is recommended whenever possible.

Zirconium and the zirconium base alloys (Zircaloy-2 and Zircaloy-3) possess excellent weldability, but like titanium, they readily absorb and alloy with oxygen, nitrogen and hydrogen when heated to high temperatures.

To combat these detrimental effects on mechanical and corrosion properties, arc welding must be conducted in a high-purity inert atmosphere. When welding is exceptionally critical, a dry-box should be used.

The dry-box is a chamber in which the work, torch, fixtures and power leads can be installed, and which can be evacuated to about 0.1 to 5 microns and then refilled with helium or argon at atmospheric pressure.

When zirconium and Zircaloy were first welded for nuclear reactor applications, the chambers were evacuated to 0.03 microns for at least 12 hours, then back-filled with helium. With today's ziconium purity, however, the slight contamination, which occurs through the relaxed standards for dry-box welding, can be accommodated.

Dry-box atmosphere can be further purified of residual air (due to insufficient pump-down or leakage during refilling) by holding an arc on scrap zirconium for several minutes. The operation is then halted when discoloration-free weld beads are obtained.

Welding zirconium outside a dry-box will satisfy many nuclear applications, and almost all non-nuclear applications, if Grade A helium or argon of guaranteed high purity is employed.

Precautions, however, must be taken when designing the shielding equipment to be used when inert-gas arc welding. Proper shielding will exclude all trace of air from the weld metal and heat-affected zone until the metal has cooled to below 700 F. (Rapid cooling can be promoted by using copper back-up plates and hold-down clamps.)

Inert-gas shielding of the weld bead's underside, plus a trailing shield, are absolutely essential if zirconium is to be welded outside a dry-box. The trailing shields must be designed to meet the weldment's contours.

A laboratory arrangement for straight seam welds is shown in figure 1, while a detailed view of the backup plate and shielding nozzle is illustrated in figure 2. The copper back-up contains a drilled manifold pass-

FIG. 2—Detailed view of the back-up plate and shielding nozzle for straight seam welding of zirconium and its alloys using the Tig process.

age which is connected to the back-up groove by a series of small drilled holes.

The shielding nozzle is a standard torch-nozzle with a lead-trail shield brazed to it. The trail shield is made of stainless steel porous-metal filter-plate brazed to a copper-sheet box-manifold.

Shielding lines should be designed and assembled to permit uniform movement of inert gas. A dead-end pocket in the shielding gas flow line, such as a Y or T fitting, cannot be purged of all air, which will then continue to bleed into the shielding gas during welding.

Indications of air or moisture in the shielding lines can often be recognized by discoloration of the electrode's end. In Tig or Mig welding, the electrode tip should be shiny-bright after welding has been completed.

Shielding lines should be grease- and oil-free, and preferably made of metal (such as annealed copper), or of high-grade plastics (such as Teflon or Tygon).

Prior to welding, the shielding lines, nozzles and back-up plates should be thoroughly purged, using about 10 times the volume of the shielding passage. After completion of the weld, the shielding gas should continue to protect the weld or heat-affected zone until it has cooled to below 700 F.

When using the Mig welding process, the welding wire should be hard-drawn and coiled to have a "cast" (diameter of an unimpeded coil) of about 20 in. or less to assure good electrical contact at the guide tube. The wire should be shiny-bright, and the Mig torch should have provisions for gas purging at the point of wire entry to prevent drag of air into the torch with the wire.

Physical and mechanical properties of zirconium and zirconium alloys made from reactor-grade sponge are summarized in the accompanying table.

The microstructure of that portion of the weld zone which has undergone fusion will consist of large transformed beta grains. In the heat-affected zone adjacent to the fused weld metal (where temperature during welding has exceeded the transformation temperature) grain coarsening will have occurred, but to a lesser degree than in the fused weld metal.

In the heat-affected zone further from the fused weld metal (where the temperature has not exceeded the transformation temperature) there will be a zone of recrystallized grains if the material had been cold worked prior to welding.

The transformed beta structure of the weld and heat-affected zone will have higher strength and somewhat lower ductility than the fine-grained alpha structure of wrought and annealed material. This is partly the result of grain size difference and partly microstructure differences, resulting from cooling from higher temperatures than those used for annealing the wrought material.

Annealing should be avoided unless the weld has been cold worked. It may cause additional grain growth, if time or temperature are high enough, thus further reducing weld ductility. Short time heating below transformation temperature will not change weld structure or heat-affected zone, but will relieve stresses already caused by welding.

The corrosion resistance of the weld metal and heat-affected zone is comparable to wrought material, providing the weld is free from contamination. Frequently the surface of the heat-affected zone will show poorer corrosion resistance than the fused weld metal.

This result is due to the fact that contaminants in the shielding gas will be concentrated at the surface of the heat-affected zone, whereas in the weld, they will be distributed throughout with a resultant lower concentration.

Physical and Mechanical Properties

	Zr	Zr-2	Zr-3
Thermal Expansion, $X10^{-6}$ in/in/F	3.2	3.6	3.6
Vol. Change on Solidification, %	1.5	1.5	1.5
Thermal Conductivity, BTU/hr/ft²/F/ft@ 212 F	11.5	8	8.5
Specific Heat, BTU/lb/°F	0.067	0.07	0.07
Heat of Fusion, BTU/lb	108	108	108
Melting Point, °F	3355	3310	3330
Boiling Point, °F	6600	6500	6500
Transformation Temperature, F	1585	1500/1825	1500/1750
Density, lb/cu.in.	0.234	0.237	0.236
Modulus of Elasticity, X 10^6 psi	13.7	13.8	13.6
Ultimate Tensile Strength, ksi	45/70	55/80	55/75
0.2% Offset Yield Strength, ksi	30/50	45/65	35/55
Elongation, per cent in 2"	20/40	15/35	15/35
Reduction of Area, Per Cent	45	35	40
Hardness, Rockwell B	75/85	85/95	80/90

Ta

. . . and its properties

Symbol	Ta
Atomic Number	73
Atomic Weight	180.88
Density at 68 F, lb/in.3	0.600
Melting Point, F	5425 ± 90
Coefficient of Linear Thermal Expansion near 68 F, microinch/F	3.6
Electrical Resistivity, microhm cm	12.4 (18 C)
Modulus of Elasticity in Tension	27 x 10^6 psi
Crystal Structure	Body-centered cubic

Resistance spot-welding of tantalum studied at Battelle

by **J. J. Vagi** and **R. L. Koppenhofer***

Spot-welding data for arc-cast tantalum sheet

Sample No.	BMI No.	Electrode Force, lb	Welding Current, amperes(1)	Weld Time, cycles	Bond Type	Pull-Out Button Diameter, in.	Bond Diameter or Nugget Diameter, in.	Penetration, per cent
			0.020-Inch Tantalum Sheet					
1	DL 1-1	700	9,400	5	Solid phase	0.062	-	-
2	1-2	700	10,200	5	Ditto	0.093	-	-
3	1-3	700	11,000	5	"	0.125	-	-
4	DL 2-1	700	11,000	5	"	-	0.13	-
5	DL 3-1	700	11,000	5	"	-	0.12	-
6	1-4	700	11,900	5	"	0.125	-	-
7	-2	700	11,900	5	"	-	0.15	-
8	-2	700	12,700	5	"	-	0.17	-
9	-3	700	12,500	5	"	-	0.17	-
10	-3	700	13,500	5	"	-	0.16	-
11	-3	250	11,000	1	Cast nugget	-	0.04	-
12	-5	250	11,000	1	Ditto	-	0.06	-
13	-4	250	12,700	1	"	-	0.08	-
14	DL 6-7	200	13,500	1	"	-	0.11	65
			0.030-Inch Tantalum Sheet					
15	DL 9-3	300	12,700	1	Solid phase	-	0.13	-
16	-4	300	13,500	1	Cast nugget	-	0.10	30-35

(a) Based on short-circuit current for machine.

A RECENT STUDY on the resistance spot welding of tantalum sheets shows that cast-nugget-type structures and solid state bonds with recrystallization where no apparent melting occurs are two kinds of bonds that can be produced.

Materials for the study were 0.020 and 0.030-in. thick arc-cast tantalum sheets. Spot welding was done with a medium-capacity spotwelding machine equipped with synchronous controls using 5/8-in. diameter, RWMA Group A, Class 2 copper alloy electrodes having a 6-in. spherical radius face.

Prior to spot-welding, the tantalum sheets were cleaned with abrasive cloth or by acid pickling with 55% H_2SO_4 (sulphuric acid), 25% HNO_3 (nitric acid), and 20% HF (hydrofluoric acid). Both methods were followed with an acetone rinse.

With all other factors equal, the different cleaning procedures produced welds of equal quality. Because of a limited supply of sheet all spot-welding tests were made us-

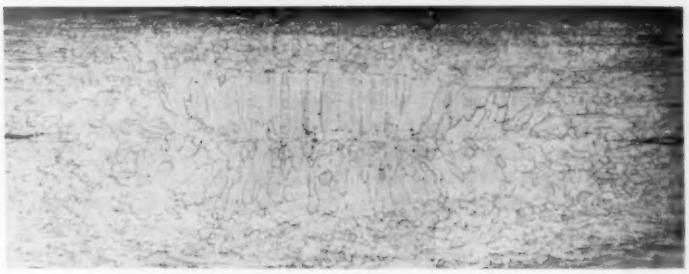
*Principal Welding Engineers, Battelle Memorial Institute, Columbus, Ohio.

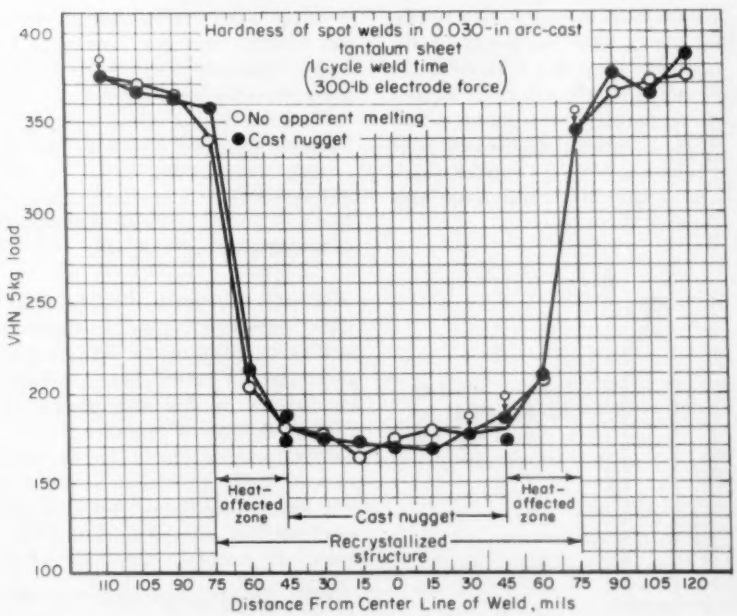
ing ¾-in. square coupons. The welds were evaluated by means of peel tests, hardness surveys, and metallographic examinations (See table).

Cast-nugget-type bond joints in which no apparent melting occurs may be satisfactory for some types of service. However, one major problem involved is the severe electrode sticking which occurs when making these type welds.

Considerably more information is needed to determine the relative serviceability of the two kinds of bonds obtained during this study. Should the solid-phase bond prove to have satisfactory properities, it may be possible to reduce or completely eliminate the electrode sticking by using higher electrode forces to reduce the contact resistance of the tip-to-work interfaces.

ABOVE, peel-test results obtained from sample which was spot-welded using conditions that produced no melting at weld surface. Micrographs of cross-sections of a typical weld showed some evidence of grain growth existing at interface, but in general grains did not appear to extend across faying plane. Typical cast-nugget structure is shown below. Structure of weld can be seen.





New Du Pont center being built to study reactive metals

A METALLURGICAL RESEARCH center to speed development of high-temperature metals for jet engines, rockets and missiles, atomic power generators, and other advanced design items, is being constructed at Du Pont Co.'s Baltimore plant, and will be completed in 1960.

The installation will contain equipment to forge, extrude, roll, draw and heat treat such reactive metals as tantalum, titanium, zirconium, columbium (niobium), tungsten and chromium. It will be capable of producing mill products—ingots, tubes, rod, sheet, strip and foil—for sales development programs.

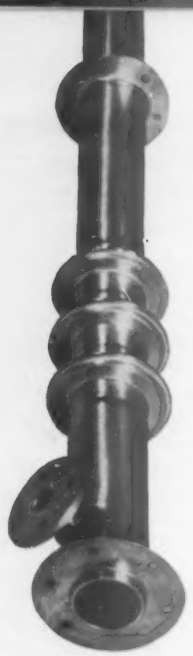
The facility, initially, will concentrate on working with titanium and pure columbium and its alloys. The center will be housed at the company plant in the Curtis Bay Section of Baltimore, where Du Pont manufactures titanium dioxide white pigment.

"Rapid advances in new and revolutionary technology in industry, power generation, transportation and communications, both civilian and military, have created a demand for new metals with outstanding physical properties," says F. H. Weismuller, general manager of the pigments department.

He added that for manufacturers to design more efficiently, they need structural metals that will withstand temperatures above 2,000 F, that have low neutron absorption, and that will operate without impairment in highly corrosive conditions.

He said columbium is one such metal that, when properly alloyed and made commercially available, will help solve many design problems in the jet engine and missile field.

Columbium alloys will also be important in obtaining improved high temperature performance from equipment used in chemical and petroleum industries, metallurgical operations, and in power generation.



VACUUM-tight high temperature furnace part made of two seamless tantalum tubes.

Ta

Tig process produces strong, ductile welds on tantalum

by Alan F. Busto*

STRONG, DUCTILE WELDS can be made on tantalum by using the Tig welding process and taking into consideration this highly reactive metal's melting point and reaction at high temperatures.

Tantalum has an extremely high melting point of 5,425 F, as compared to approximately 2,700 F for most steels. Also, at elevated temperatures (600 F and higher) tantalum combines with oxygen, nitrogen, hydrogen, in fact, it combines with all but the inert gases.

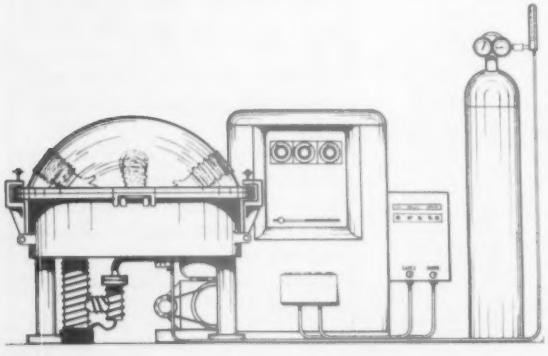
Other points must also be kept in mind: the thermal conductivity of tantalum is somewhat lower than that of steel; the thermal coefficient of expansion is about half that of steel; when welding tantalum all undesired gases must be kept away from the weld area. Aside from these points, the physical properties of tantalum and mild steel are similar.

Because of its relatively low work hardening rate, it is not usually necessary to anneal tantalum before welding. It is however, best to clean the metal thoroughly.

It is also necessary that the weld and heat affected zone be flooded with an inert gas to exclude all gaseous contaminants that could reduce the ductility of the weldment.

Helium, argon, or a mixture of the two can create an atmosphere to which tantalum is inert at all temperatures. And, when the purity of the gas is maintained at a high level, the weld and heat affected zones exhibit ductility similar to the parent metal.

Where a perfectly ductile weld zone is required, a welding chamber which can be purged of air and filled with inert gas is desirable.



TYPICAL welding chamber which can be purged of air and filled with inert gas.

Essentially, a welding chamber provides a perfectly sealed enclosure which allows a wide visual range; arm holes or a remote control device to manipulate the weldment; a pure inert gas supply; a vacuum system to evacuate the air where purging is not considered satisfactory; a welding system including power supply, torch and ground cable.

Refinement of the system can allow placement of parts in all positions, access ports for removing parts without contaminating the atmosphere, multiple glove openings, automatic gas controls, and other necessary accessory equipment to suit specific manufacturing requirements.

Fixturing within a chamber serves the main purpose of locating the adjoining components, prior to and during welding, in correct alignment. In many cases, parts can be designed to be self-aligning (Fig. 1).

Where this joint design is possible, light clamping and preliminary tacking is adequate to hold proper alignment. In cases where the holding fixture is the sole means of alignment, internal expanders, external clamps, hold downs, fingers, etc., must be used. Provisions in the fixture design must allow clearance for inert gas flow around all heated surfaces. If backup plates are used,

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they must have deep, wide grooves open to the atmosphere.

To weld a sealed assembly, provisions must be made to either assemble after purging or add weep holes for gas circulation during welding.

In many cases the use of a welding chamber is impractical because of the weldment's size or shape. In such cases the heated surfaces can be protected by proper gas-backed fixturing which usually serves three purposes:

1. To hold the work in proper alignment.
2. To chill the work in order to limit the heat affected area.
3. To act as a seal to exclude the outside air and to conduct the inert gas to the heated areas.

Although this procedure seldom provides sufficient inert gas purity in the weld area to accomplish welds equaling the parent metal ductility, the weld metal ductility will exceed practical requirements. Weld bend ductility of 180 deg bend over one metal thickness can be consistently accomplished where backup gas fixtures and a gas filled trailing cup are used.

Weld fixturing falls into two general categories, depending upon whether the weld is a longitudinal one or a circumferential one. Fixturing for longitudinal welds consists of a grooved backup, drilled for gas flow or with a porous backup material, and copper alloy toed hold down clamps (Fig. 2).

The copper chills the work to restrict the heat affected area. The groove conducts the inert gas to the backside of the weld area which must flow without turbulence to prevent aspiration of air. Backup groove dimensions (See Table I) are recommended to provide alignment and chilling with sufficient clearance to prevent copper pickup in the weld.

Circular butt-welded joints are accurately aligned by expanding circular backup fixtures. The fixture can be used for tacking, preliminary to welding, or as a welding backup fixture. In the first case, the tack welded assembly is removed from the fixture to a circular weld positioner and welded with inert gas backup and trailer cups (Fig. 3).

In the latter case, the gas is supplied to expanding segmented backup

Fig. 1
EXAMPLE of self-aligning joints.

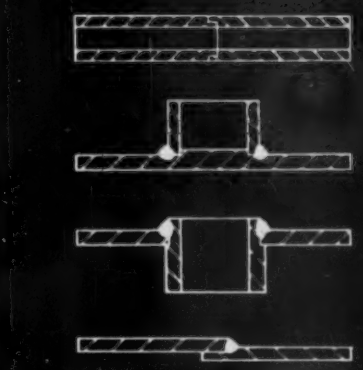


Fig. 2
CONSTRUCTION on longitudinal weld fixture with copper backup drilled for inert gas. Fixtures are used when self-aligning joints cannot be obtained.

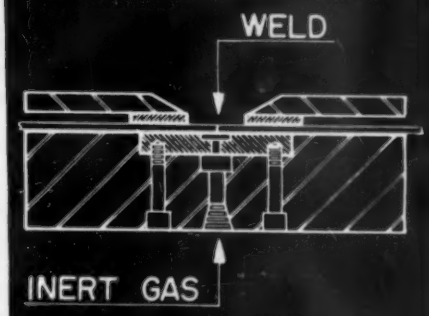


Fig. 3
CONSTRUCTION on longitudinal weld fixture with porous metal backup.

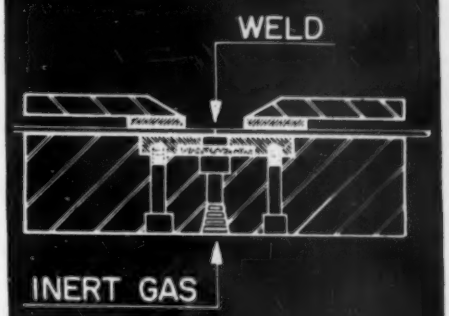
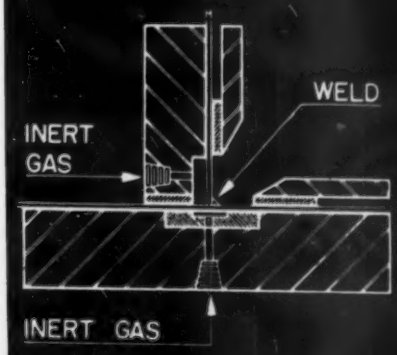


Fig. 4
FILLET welding fixture to perform the functions of holding alignment, chilling and inert gas backing.

Fig. 5
CIRCULAR butt-weld with gas backup and trail cups to cover the heated area with inert gas until it is cool.



of a design similar to Fig. 4. Hold down clamps are not required because the parts are held in tension by the outward force of the expander.

The welding power source most desirable for Tig welding tantalum is a d-c rectifier type machine capable of maintaining an arc at 10 to 300 amp.

Accessory equipment should include a remote control foot switch with a connector relay switch to extinguish the arc at the conclusion of a weld pass. Solenoid control of torch, trail and backup gas with purge and post-weld gas flow timing intervals is a desirable feature to insure controllable gas coverage without gas waste. High frequency arc initiation is mandatory to avoid tungsten pickup in the weld fusion zone.

A motor generator set with the necessary accessories will be adequate for most welding operations, although it is not preferred because of slow arc response to remote current controls.

The welding torch should be a 300 amp capacity water cooled manual or machine torch, depending upon the application. The welding nozzle size should be as large as is feasible to provide maximum inert gas coverage over the molten puddle with low gas velocity. The electrode size depends upon the welding current. Thoriated tungsten electrodes are recommended because of their excellent arc initiation and arc stability characteristics.

GROOVE		TANTALUM
WIDTH	DEPTH	THICKNESS RANGE
1/16	.040	.004 — .014
1/8	.040	.015 — .025
1/4	.050	.025 — .050
1/2	.050	.050 — .125

The choice of helium or argon for welding tantalum is dependent upon many factors. Although helium is approximately one-half the price of argon per standard cubic foot, it requires twice as much helium for the same coverage, so that economy is usually not a serious consideration. Because helium is not as readily available as argon, it is less desirable on large production jobs.

Where backup cups or large diameter expanding fixtures are used, the low density of helium relative to air is a desirable factor. The lighter helium forces the air down and away from the backside of the weld joint. Conversely, argon is more desirable on the top surface because of its greater density relative to air.

The most important considerations in the choice between argon and helium as an inert welding gas is their individual arc characteristics.

Normal Tig welding voltages in an argon atmosphere are from 10 to 12 volts d-c straight polarity and 16 to 20 volts in helium. These values are for similar arc lengths.

Therefore, by holding all other variables constant and equal, power input is greater with helium at the same welding current. Helium, then, is the preferred cover gas on tantalum weldments of 0.040 in. or heavier because of its high arc potential.

It is difficult to strike an arc in helium at less than 30 amp, whereas an arc can be initiated in argon at 10 amp. So, on thin metals normally encountered in chemical equipment, argon must be used to prevent excessive penetration or burn through.

Tantalum is shipped cleaned and ready to use. If, during unpacking, the material picks up dirt and oil, cleaning by degreasing will be satisfactory before welding.

If there is pickup which cannot be removed by degreasing, a chromic acid solution can be used. The solution proportions are 100 grams potassium dichromate to one gallon concentrated sulfuric acid. The bath temperature is 195 F.

If further cleaning is necessary, the recommended etching solution for tantalum is nine parts hydrofluoric acid, 70% concentrate to one part concentrated nitric acid. This solution is extremely corrosive to tantalum and requires that the etching time be limited to five seconds and then water rinsed.

After cleaning, the tantalum must be wiped dry or dried in a warm air draft. Immediately prior to welding, a final cleaning with a cloth saturated with alcohol is recommended to remove surface dust and finger marks in the weld area.

THIS reboiler was lined with approximately 18 sq ft of 0.020-in. tantalum sheet, assembled by Tig welding.

Most of the statements in this article referring to the welding of tantalum, apply equally well to the welding of columbium (niobium). The principal difference between the two metals is that the melting point of columbium, 4,379 F, is somewhat lower than that of tantalum.

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ROAD RIPPER TEETH *averaged 7 to 10 times more life after receiving protection with Tube Borium. Notice how tooth chisels down with wear.*

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More expensive in first cost, Tube Borium shows excellent economy in overall service life, outlasting other materials many times over. And longevity is not your only benefit. Remember, one major cost of any hard-facing application is welding time. Use the best, Tube Borium, and you'll save several applications of less effective alloys besides eliminating needless downtime!

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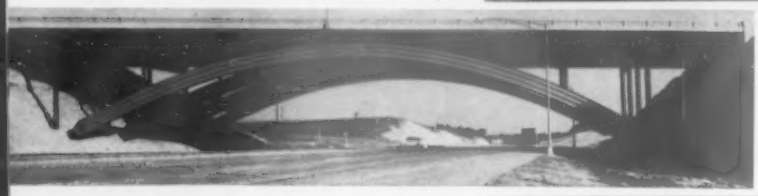
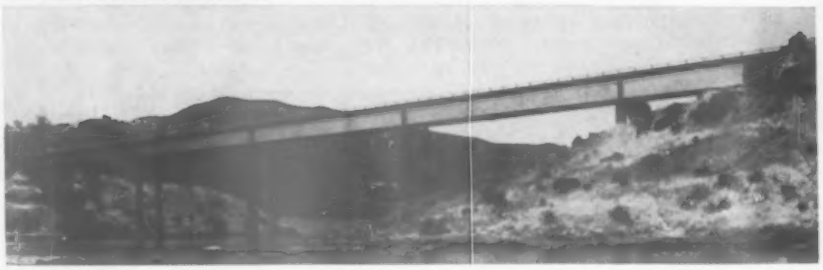
WHITE Salmon River Bridge, Klickitat County, Washington, received an honorable mention in Class 3. The $57,184-bridge has one 120-ft span, two 14-ft 11-in. spans, and two 14-ft 6-in spans.

FIRST honorable mention was awarded the Trinity River Bridge, Hoopa, Calif., an entry in Class 2 for bridges with fixed spans under 400 ft and costing more than $500,000. This bridge cost $737,000 and is composed of a 200-ft span, 170-ft span, 169-ft 4-in. span and an 80-ft span.



HAMPTON Road Overpass, Dallas-Fort Worth Turnpike, Dallas, Texas, was award winner in Class 3 for bridges with spans under 400 ft and costing less than $500,000. This bridge has a 192-ft span, and cost $325,832.

HONORABLE mention was awarded to Putah Creek Bridge at Monticello Reservoir in Napa County, Calif. Also a Class 3 entry, it cost $444,000 and has four span lengths of 166 ft, and two at 75 ft.



Grace, beauty, simplicity— special endowments of these welded-steel contest winners

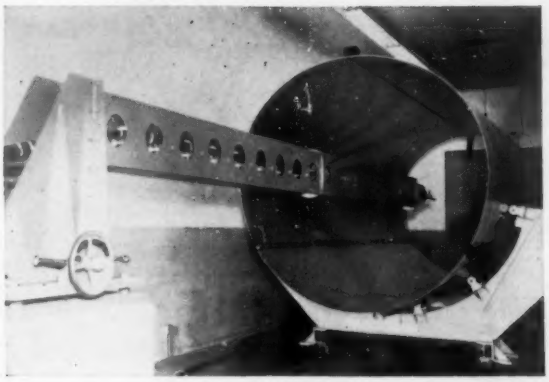
WHEN BUILDING A FUNCTIONAL aid to society, you do not have to create something void of aesthetic quality. If you build a bridge, why not build a beautiful one?

This is the philosophy of the American Institute of Steel Construction, Inc., headquartered in New York City.

The Institute wants to promote a widespread appreciation of the aesthetics of steel bridges, and to honor the architectural excellence of modern bridge design. To do this, an annual Prize Bridge Competition is held, in which art directors, architects and engineers select the steel bridges they feel were the most beautiful opened to traffic in the United States during the previous year.

The contest is divided into four classifications, with size, cost and operating conditions determining what class bridges enter. Prize winning bridges are marked with a stainless steel plaque, while designers, owners and steel fabricators are awarded engraved certificates.

Shown on this page are four award winners from the 30th annual competition—these being all-welded steel bridges combining grace and beauty while serving their purpose.



X-ray boom in position within the shell for radiographing weld seams in missile body.

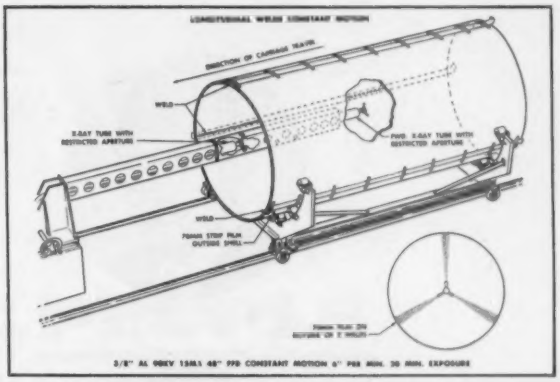
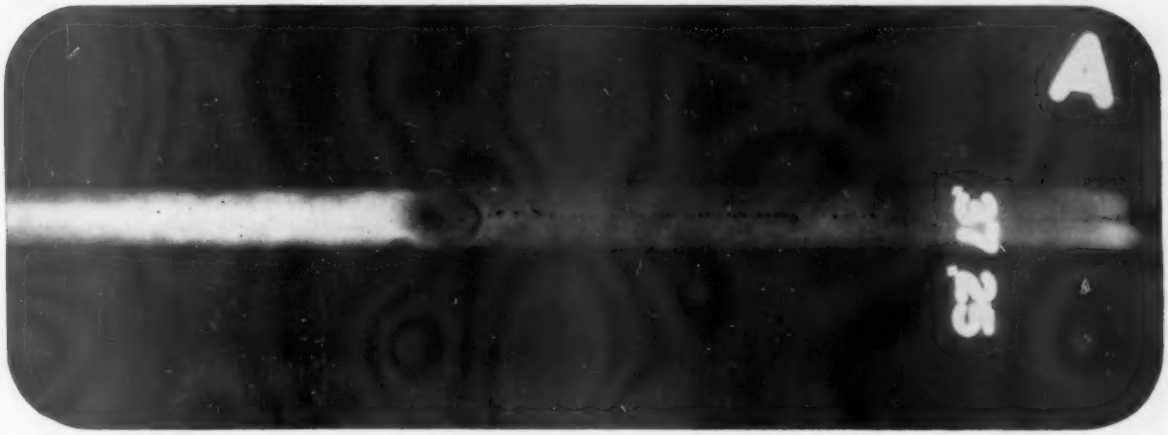


Diagram shows how three longitudinal seams are x-rayed simultaneously.



Radiograph revealed crack and porosity which must be repaired.

Three hour x-ray job cut to thirty-five minutes

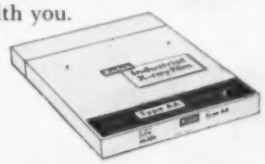
To speed Air Force missile program, Douglas develops unusual exposure technique

Ordinarily the longitudinal weldments of the three segments making up this missile tank would be radiographed by an external source using successive exposures of individual film cassettes mounted along the weld inside the tank.

To meet production schedules and reduce costs, Douglas Aircraft Co. devised the method shown in the diagram. Strips of 70mm Kodak Industrial X-ray Film are placed along the welds on the outside of the tank. Two rod-anode type x-ray tubes, fixed on a boom extending within the shell, project x-rays through lead slits to all three weldments. In making the exposure, the tank is moved half its length by electric drive, each half passing through the radiation of one of the x-ray tubes.

Using Kodak Industrial X-ray Film, Type AA adds to the savings in time—for this film has the extra sensitivity and speed to allow shorter exposure.

In all applications, Type AA Film is producing quality work in less time—also extending the service of present x-ray equipment. To see how you can save time and money, discuss it with your Kodak x-ray dealer or write for a Kodak Technical Representative to call and talk it over with you.



Kodak Industrial X-ray Film, Types AA, M, and KK are available in 70mm by 550 ft. as well as in standard size packages of 75 or 100 sheets.

X-ray Division, EASTMAN KODAK COMPANY, Rochester 4, N. Y.

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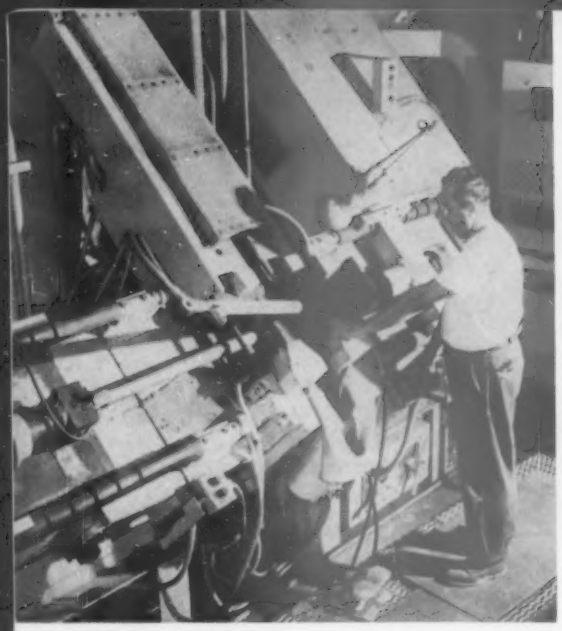
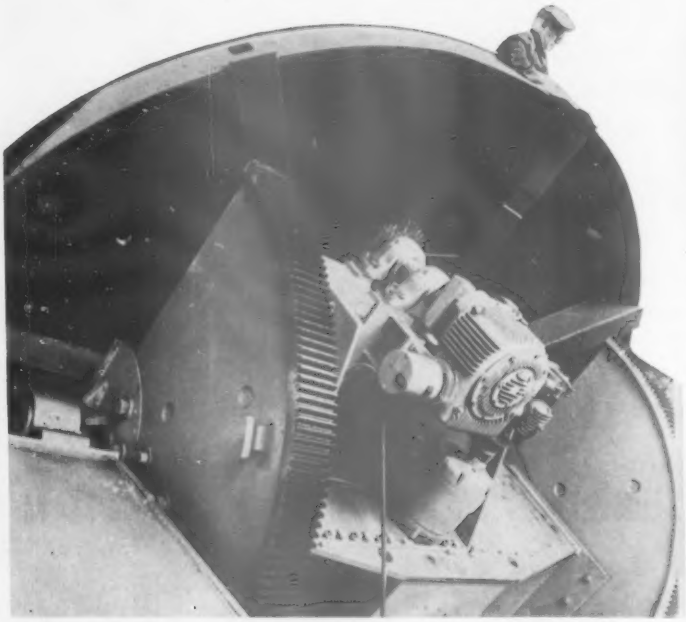


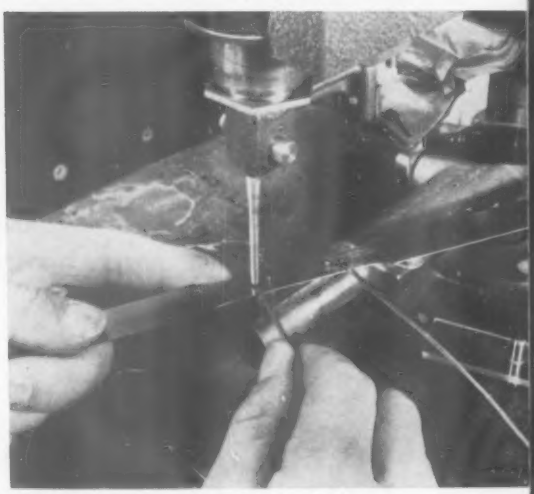
ARRESTING hook of Douglas F4D-1 Skyhawk is being flash-butt welded. Stainless steel tube is welded to forging on 500 kva machine. Each weld in its heat-treated condition will withstand 300,000-lb strain. Hooks are used when Skyhawk lands on aircraft carrier deck. Because of tremendous speed of jet craft, hook is needed to snag strong cable and help slow plane down in relatively short distance available.

GENERAL Ionics Corp. of Pittsburgh, manufactures water softening tanks made of stainless steel supplied by Allegheny Ludlum Steel Corp., Pittsburgh. Here, automatic welder makes center seam on tank at rate of 40 ipm. Type 308 filler rod is fed from wheel at right, while flux is fed from tube in front of weld point, keeping atmosphere from weld, and acting as stabilizing agent. Prior to welding, cylinder is tack-welded in three places, after welding, cylinder is buffed.

On the job...



ONE of world's largest positioners, built by Plainfield (N. J.) Div. of Worthington Corp., has begun to work for Bucyrus-Erie of Milwaukee, when welding large frames for power shovels. Positioner has 200,000-lb capacity at 24-in. center of gravity and 24-in. eccentricity. Machine is close to 14-ft high with table horizontal, has 50 hp on tilt, and uses two synchronized 25 hp motors to drive tilt.



RESEARCH engineers of Boeing Airplane Co., Seattle, Wash., have developed a new method of attaching extensometer arms to test specimens for protracted elevated-temperature tensile tests. Technique centers around ordinary 3/32-in. steel balls, welded to test specimens under precisely controlled conditions. Balls attach to sockets on extensometer arms in traditional ball-and-socket linkage. Temperature recording thermocouples are also welded to specimens. Picture shows position of welded steel balls and thermocouples on tensile test specimens.

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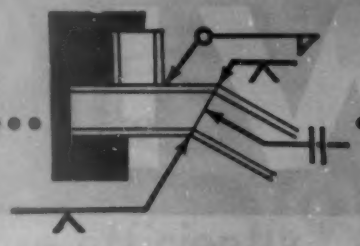


the welding clinic

Here you may find the solution to your welding problems, whether they concern design, production, construction or maintenance welding. Submit your questions for answering on this page.

How to make a safe cable splice in the field

Question:

How can I make a quick, but effective and safe welding cable splice in the field without the benefit of proper equipment?

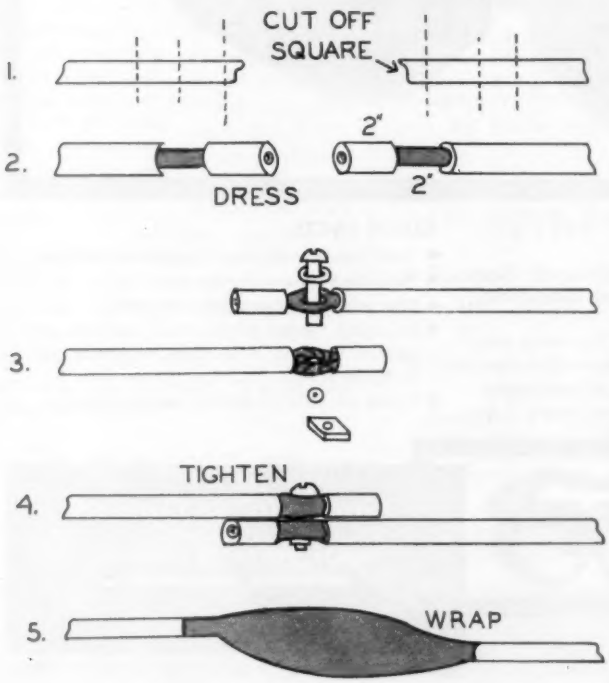
Answer:

To get a temporary, effective and safe welding cable splice in the field without too much equipment, follow the five steps suggested by Andrew Vena, a weldor from Philadelphia.

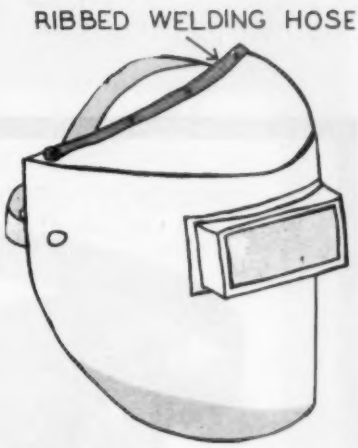
First, trim the ragged ends of the two pieces of cable, and cut them square at the ends with a hacksaw (Fig. 1). Then, about 2 in. from the squared ends, remove about 2 in. of rubber, leaving the strands bare (Fig. 2).

Spread the strands of the bared 2-in. portion so a bolt can pass through both cables (Fig. 3). Place a washer under the head of the bolt and another above the nut.

Tighten the bolt, compressing the two pieces of cable together into a mechanically and electrically secure joint (Fig. 4). To complete the job, wrap the joint with rubber tape first, then with friction tape so it will be able to withstand handling and scuffing on the ground (Fig. 5).



FIGURES 1 through 5 show the various stages of making a welding cable field splice when proper equipment is not available.



Question:

A source of petty annoyance to every weldor comes at the end of every tack, weld or rod, when his helmet has to be lifted. No matter how carefully the head bands are adjusted, many times the helmet comes loose, and sometimes falls off at inconvenient moments, such as when the weldor is working at a great height. Is there anything that can be done to avoid this?

Answer:

Again, Andrew Vena has the answer to the problem. He suggests taking a scrap of ordinary ribbed gas welding hose and attaching it along the top edge of the helmet with some small bolts (See drawing).

After the hose is attached, to swing the helmet away from the face, place your hand on the ribbed material, and by using a swing-back-press-down force, the helmet is slid back to position without coming loose from the head.

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Meet the new AO 329A Welders' Coverglas Goggle — with a wide range of vision and fitting ease.

Designed to exceed government specifications, the 329A: (1) Fits over all types of correction spectacles, including those with decentered temple pieces. (2) lenses measure 50 mm. round.

In addition to offering superb fitting qualities proven by tests, the 329A simplifies lens stocks since it accommodates 50 mm. rd. lenses used as standard in all other type goggles regularly used. (Users prefer a large cover goggle with 50 mm. rd. lenses.) Also, the goggle has increased ventilation and a more attractive appearance.

The 329A protects against injurious light radiation, glare and flying sparks. A companion chippers' model (325A) is identical except for its direct ventilation and clear lenses. Your nearest AO Safety Products Representative can supply you.

QUICK FACTS

- Solid fiber lens retaining rings prevent light leaks.
- Indirectly ventilated side louvers.
- Filterweld No. 5 shade lenses standard.
- Adjustable leather bridge. Also available with rigid bar bridge as 329B and with adjustable rigid bridge as 329R.
- Frames are cellulose acetate, opaque brown.

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Research pays off!

Welding helps produce tractor rollers more efficiently

TRACTOR ROLLERS are usually produced by casting, but recently a manufacturer of tractor replacement parts developed another method.

A research team at Wes Trac Co., Torrence, Calif., designed the roller as a two-part forging to be welded. A trial order was placed, and in production the parts were joined by manual metal arc welding. Results of welding tests were successful, and the method was put in operation using Linde Co.'s automatic submerged arc process.

The welding fixture is equipped with two spindles to turn roller assemblies under the welding head. As welding proceeds on one roller, a new roller is assembled on the other spindle. The welding head is moved from one station to the other by a hydraulic cylinder.

THIS forged and welded tractor roller has just come from fixture. Fused composition detached itself and left weld clean and smooth. It is ready to be machined and hardened.

Production averages 100 units per operator in an eight-hour day. Each two-pass weld is made in 4 minutes and 40 seconds. The bead surface is smooth and reinforcement low, minimizing machining. Each weld is made under identical conditions, and rejects have been eliminated.

The new method of production is the result of a general review which Wes Trac carries out regularly on each of its products to see if better manufacturing methods can be found.

Performance checks on the new tractor rollers revealed that they last at least 50% longer than cast rollers.

"DURO is the coolest"*

*says Ben Ruff of Reed & Graham, Inc. "Before I had to change holders whenever the one I was using would get hot. Now, with DURO, I can weld a whole shift without the holder getting hot to my hand, even when using 5/16 in. hardfacing electrodes at high amperages."

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- Rugged fibre handle—lasts longer
- Cool operation—cool handling

Featuring "Long Jaw Design" for reaching those "hard to get at places."

The DURO "DUROGON" Tong-Type

- All parts quickly replaced with a screwdriver
- Fully insulated—greater safety
- Cool operation—cool handling
- DUROGON-N3—Aluminum body—extremely lightweight; less operator fatigue; mechanical cable connection
- DUROGON-N3HD—Bronze body—heavy duty operation; mechanical, soldered or brazed connection.
- "The BEST of this popular design"

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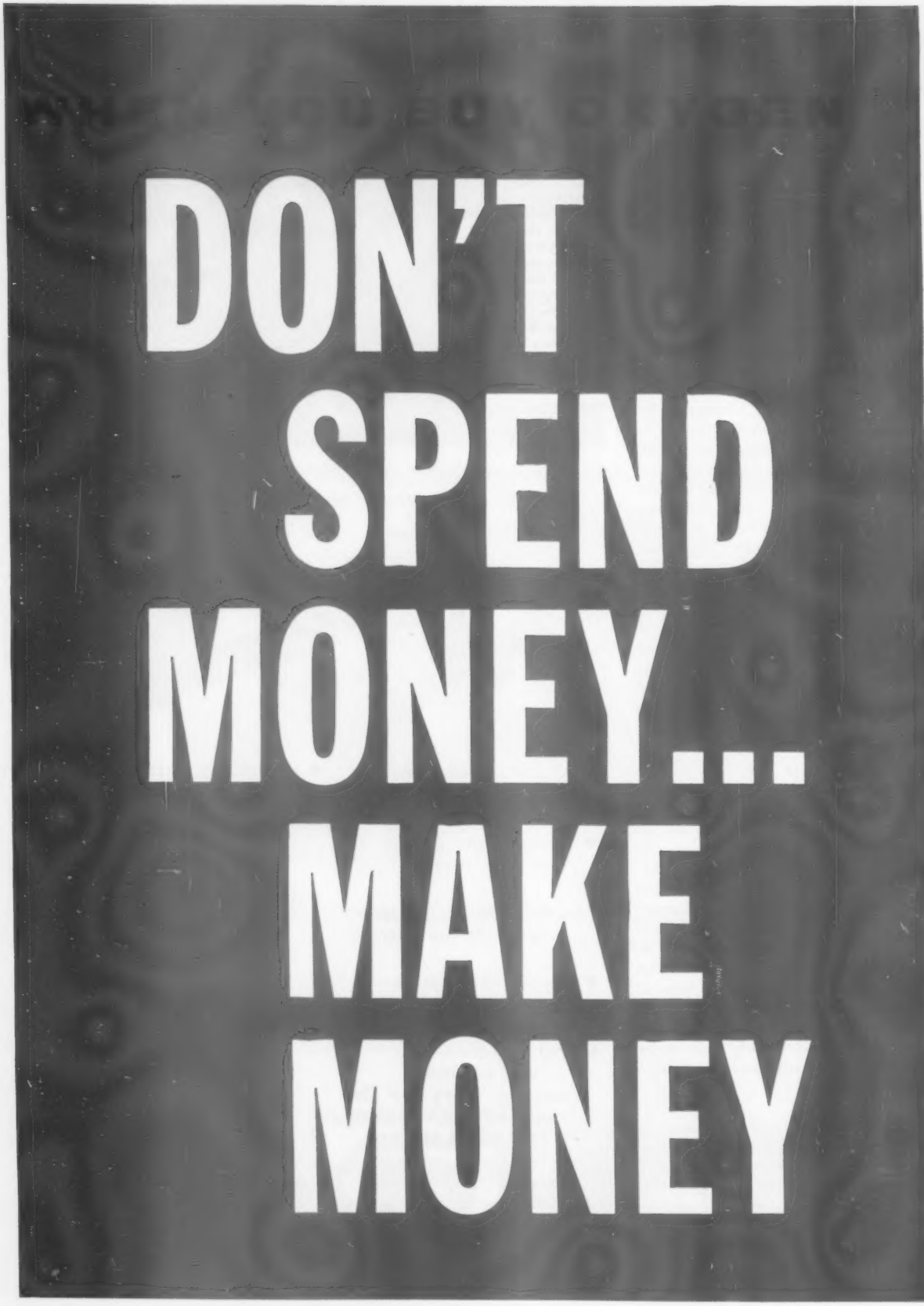
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WELDOR spot welds supports to fuel-trailer side panel.

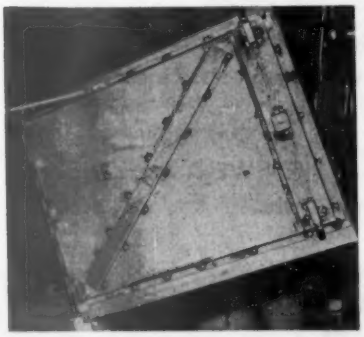
Spot welding cuts fuel truck production time

TACK-WELDING operations used by a manufacturer of 2,500-gal capacity fuel trucks were slow, caused considerable distortion, left mill scale and dimples on light-gage materials.

R. L. Faubion Co., Kansas City, Mo., manufacturer of fuel and pressure tanks, and truck and tank trailers, decided it was costing too much to grind and clean scale, fill dimples with metal or plastic before painting, or compensate for distortion.

The company's engineers looked for an answer to their time and cost-consuming problems. They found it in the form of a Linde Co. Mig spot welder—self-contained and portable—that makes welds in three seconds.

Not only did the new unit prove speedy, it made welds from one side only, causing no distortion or dimples. Post-welding operations were completely eliminated, and production time was slashed 35%—from 10 days to complete a fuel trailer to 6½.



THESE spot welds require no postweld treatment.

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Model G

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Model G Gun supplied with 15 ft. cable, 2 nose guides and 1lb. BREN/WELD #16 electrodes, ready to operate. Just connect to electrode holder of your arc welder.

SPOT WELDS FROM ONE SIDE

ARC SPOT WELD GUN

Automatic Time Control
AUTO BODY WORK • DUCT WORK
TANKS • CABINETS • ROOFING
PLUMBING • SIGNS
NO EXPERIENCE REQUIRED

Designed for use with BREN/WELD equipment.

INDISPENSABLE FOR AUTO BODY AND SHEET METAL WORK OF ALL KINDS

Now for the first time spot welds can be made with a light weight, automatically timed spot weld gun. Absolutely no experience required. The gun does all the work. Just press against the spot to be welded. No triggers or levers to operate at a certain moment. Just press and weld. Welding current shuts off automatically after predetermined time set on control dial. Every weld uniformly perfect.

OUTSTANDING FEATURES:

- Many times faster than any other method of fastening
- No distortion of metal
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- All metal construction, no plastics
- Welds from one side
- Precision made for long trouble free use
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- Recommended for use with BREN WELD Power Supply or BREN WELD Arc Welder
- Weighs less than 2 lbs.

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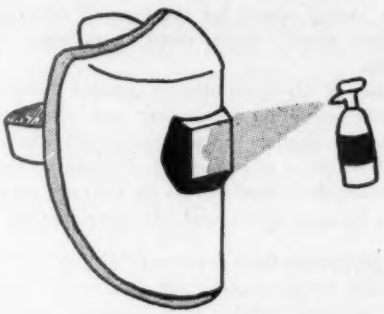
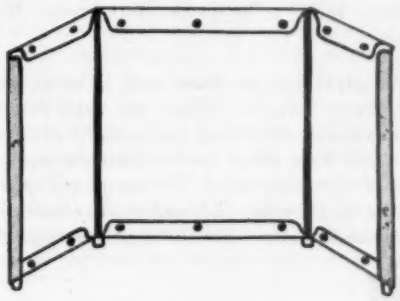




Glycerine: an important factor in the welding industry

by **Clement F. Brown**

TO THE AVERAGE LAYMAN, the word "glycerine" is nothing more than the suffix of "nitro" and thus is associated with a big, loud noise.

Such ignorance notwithstanding, glycerine is of great importance to the welding industry, to say nothing of its value in the chemical and other industrial fields. (More than 1,500 uses have been attributed to it.) It is an important constituent in spatter preventives, soldering fluxes, certain electrode coatings and anti-fogging and fire-proofing compounds.

Chemically, glycerine is a trihydric alcohol. In non-chemical parlance, it is a sweet-tasting oil—clear, generally colorless and syrupy. A major by-product of the soap industry, it is also synthetically produced in large quantities from petroleum sources.

In soap making, glycerine is formed as fat parts are broken apart by the action of soda and brine in a fat-splitting process. It is then washed off.

In the welding shop, glycerine's most important direct-production use is in spatter preventive compounds. As a component in these anti-splatter and anti-flash products, it acts as a plasticizer. The compounds are soap-type materials in water, containing pigments where greater protection from weld spatter is required.

After such a preventive is applied adjacent the weld areas, the water evaporates. The coating that remains contains the glycerine (as a synthetic alkyd resin) which gives it more flexibility and makes the dried film easy to remove after welding operations are completed.

The compounds are water soluble—readily washed off with water or metal-cleaner solutions; when the weldment has been conditioned by wire brushing or grit blasting, additional operations for removal are not required.

Two types of anti-spatter compounds are in general use. One is a thin, transparent jell—best suited for use on light weldments featuring single-pass welds. Harmless to the skin and non-flammable, it is readily applied by

brushing, swabbing or spraying (using a pressurized container).

The second type is a pigmented (usually white) creamy liquid. It can be applied by any convenient means and is safe and harmless. This product is recommended for multi-pass welding and for single-pass where heat becomes intense—usually because of heat conductivity of the metals being joined.

It is also used effectively to prevent flash adhesion to dies and jaws of automatic resistance-welding machines. When used for this purpose, it is important that the compound be allowed to dry thoroughly before using the equipment. The coating is quite durable and, when properly used, permits five to ten times as many welds between applications—greatly reducing the cost of cleaning weld flash.

As welding aids, anti-spatter compounds save a lot of man-hours. Descaling, grinding, wire-brushing and other cleaning operations are greatly minimized or completely eliminated. Properly used, no harmful effects are suffered by the weldor or the weld metal. Nor are any injurious fumes or offensive odors created by these compounds.

Another glycerine product used in many shops is glycerine-litharge cement. While not used directly in welding operations, this luting compound finds frequent use on the test floor where heat exchangers and similar weldments are pressure tested. The compound is a paste-type mixture of glycerine and lead oxide (litharge) and is extremely useful as a sealer of "dope" for pipe fittings and other threaded connections.

Glycerine is an excellent lubricant; therefore, this sealer is ideally suited for the type of temporary joint preparation usually encountered in pressure testing of weldments.

The use of glycerine-litharge cement becomes practically mandatory in the testing and use of heat exchangers and similar process equipment where contact with hydrocarbons is prohibited. Pipe-luting compounds with a mineral-oil base cannot be tolerated in these applications because all mineral oils contain hydro-carbons.

The glycerine-base cement is also an excellent pipe cement for permanent use. It sets up a hard bond of great strength. Setting time depends upon age and quality of the litharge.

To avoid waste of this fast, hard-drying compound, small quantities should be mixed only as needed. A major manufacturer of valves and fittings offers a cement kit as a standard packaged item. Correctly-proportioned amounts of glycerine and litharge—sufficient to lute the threads of about 25 fittings—are packed in separate containers. They are mixed just prior to use.

As a constituent in soldering fluxes and pastes, glycerine plays another important role. The glycerine additive gives the flux adequate surface tension to insure a thorough wetting of parts to be joined. It is used in the common zinc chloride and muriatic acid solutions to help prevent water spatter when heat is applied to the flux.

These fluxes are usually applied by brush. One

HI-AMP

ELECTRODE HOLDERS

CABLE ATTACHMENTS

GROUND CLAMPS

Offers

T.P.C.*

* THREADED POWER CONNECTION

Excessive heat in a welding circuit is oftentimes caused by a resistance build-up at some point in the welding circuit due to connections being loose or oxidization setting up in a mechanical type of terminal connection.

Shown in the above "cut-a-way" picture of an Electrode Holder is the new HI-AMP, T.P.C. type of connection that can be adapted to ground clamps and quick disconnect plugs as well as to electrode holders.

T.P.C. means a Threaded Power connection using the pressure of threads on a sleeve to drive the ends of any welding cable down into the depth of a cable socket, then locked into place with threaded plugs. An excellent electrical connection as well as providing direct contact with the welding cable to the accessory so that maximum heat is conducted into the heat-absorbing cable.

ASK YOUR WELDING SUPPLY HOUSE FOR FURTHER INFORMATION

354 W. ADAMS ST. LENCO, INC. JACKSON, MO.

manufacturer reports that as much as 10% glycerine is added to this type of flux as a plasticizer.

Glycerine is an important component of cream solder, being present in varying amounts as a plasticizer. Self-cleaning and self-fluxing, these solders reduce production costs as much as 50% in some applications. Fast and efficient and less wasteful, they often increase the range of soldering applications. They especially facilitate work on small parts and assemblies, where soldering irons would be difficult to manipulate.

Here again, by its affinity for moisture, glycerine aids in prevention of water spatter upon application of heat. Cream solder is usually applied to the joint with a brush; the joint is heated with a torch; and the job is finished.

While electrode manufacturers are secretive about coating formulas, glycerine reportedly is an additive in some of these fluxes. In certain types of general-purpose electrodes (EXX10, EXX12 and EXX20 series) as well as in some types of iron-powder electrodes, an arc-operating atmosphere with a controlled moisture balance plays an important function in the welding process.

Glycerine-containing wetting agents are added to premixed powders to form a mixture of doughy consistency. The mixture is fed through extruding machines to coat the wire base metal. The coated electrodes are then dried or cured by baking and subsequently sealed.

Electrodes with this kind of a coating have improved storage characteristics. Because of glycerine, the coatings do not readily dry out, and breaking and crumbling are retarded.

Electrodes in the low-hydrogen group, of course, contain no glycerine. In their usage, moisture is a distinct detriment to the arc atmosphere.

In semiautomatic and fully automatic welding equipment, glycerine is often found as an additive to the coolant. Its tendency to supercool at low temperatures rather than to crystallize makes it an outstanding permanent base anti-freeze for the packaged inert-arc and submerged-arc units whose nozzles are water cooled.

In addition to the uses cited, glycerine finds applications in many safety products in weld shops.

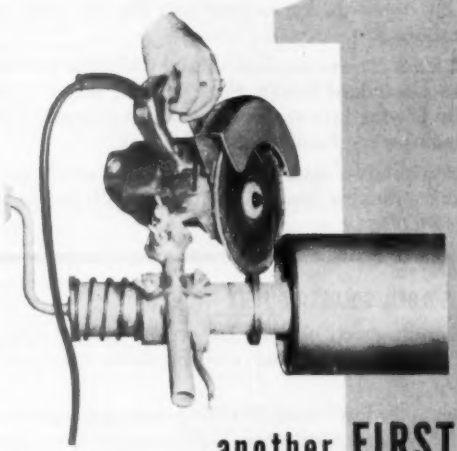
Weld-booth curtains are often initially treated with glycerine-containing solutions. When thus treated, the curtains are fireproof, for glycerine presents no fire hazard in any product and is also non-toxic. They are also softer and more flexible—glycerine's presence tends to combat stiffness caused when materials are dried out by the heat, smoke and fumes of welding.

One manufacturer markets a fireproofing liquid (containing about 3% glycerine) that can be applied by spraying or dipping. It can be used to treat fibrous materials that can absorb water solutions.

Properly impregnated, a weldor's protective clothing —gloves, sleeves, aprons, etc.—will last longer and stay more flexible.

Glycerine is also used in anti-fogging compounds for goggles and helmet lenses. It has even been added to ultra-violet ray protective paint to reduce harmful glare from weld booth walls. Still another application: as an explosion and fireproof lubricant for some types of equipment for handling oxygen and other gases.

PATENT NO. 2,869,293



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COILED WELDING ROD: Available in standard mill-wrapped coils approximately 55 lb in weight. Etched or commercial finish; several alloys are available for immediate delivery, others fabricated on request.

STRAIGHT-LENGTH WELDING RODS: Thirty-six-inch straight-length welding rods, packed in 5-lb tubes; 10 tubes to a standard shipping carton. Other alloys and sizes fabricated on request.

WELDING FLUX: Available in jars of 8 oz, 1 lb, 5 lb; drums of 50 lb and 150 lb. General use is for oxyacetylene or oxhydrogen gas welding. No. 22 flux, colored deep pink to facilitate identification.

BRAZING SHEET, ROD AND FLUX

BRAZING SHEET: Made as a one- or two-sided clad product with the filler metal integrally bonded to a core alloy, or in the form of shim stock of a brazing filler alloy.

COILED BRAZING ROD: Standard wrapped coils with etched or commercial finish in sizes from ¼-in. to 1/16-in. types available for standard or specialized brazing operations.

STRAIGHT-LENGTH BRAZING RODS: Thirty-six-inch straight lengths packed in 5-lb tubes, 10 tubes to a standard carton. Sizes from ¼ in. to 1/16 in. May be applied either by flowing into the joint when torch brazing or as wire rings or other shapes when furnace or dip brazing.

BRAZING FLUX: Four types available, color coded for identification purposes. Available in packages ranging from 8-oz jars to 150-lb drums to fill any brazing requirement.

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SHEET: Zinc-coated aluminum sheet, clad on either one or two sides. This new product permits easier joining and provides maximum resistance to corrosion.

SOLDER: Two types available for low- or high-temperature applications. Available in a variety of spool and stick sizes; high-temperature solder can be used to join aluminum with copper, brass, steel, stainless steel, nickel, etc.

SOLDERING FLUX: Several types available for use with both high- and low-temperature solder. Available in packages ranging from 1-oz bottle to 150-lb drum.

Any of the distributors listed can give you full information on aluminum welding and brazing processes. Also, a number of films are available from Alcoa on a loan basis. Further information is available from Aluminum Company of America, Pittsburgh 19, Pa.

For exciting drama watch "Alcoa Presents" every Tuesday, ABC-TV, and the Emmy Award winning "Alcoa Theatre" alternate Mondays, NBC-TV

Want technical help in welding, brazing or soldering aluminum? Contact your Alcoa sales office, listed under "Aluminum" in the Yellow Pages of your phone book.

For immediate delivery of Alcoa welding products, call your Alcoa outlet listed below. He carries a complete range of alloys and sizes.

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TROUBLESOME pump with eroded inner walls is shown with front cover casting removed.

Quick repair keeps royal frigate on move for seaway opening

TWO FOUR-INCH GUNS on the British Royal Navy frigate *HMS Ulster* boomed out a 21-gun salute as the vessel approached the harbor. The 2,200-ton anti-submarine frigate, serving as part of the escort fleet for Queen Elizabeth during the opening ceremonies of the St. Lawrence Seaway, was about to pay a courtesy visit to Detroit.

While most of the 180-man crew were concerned with the ceremonial aspects of the historic visit, the ship's engineering officer was looking forward to the Detroit stop for an entirely different reason.

Erosion had damaged the inner walls of the *Ulster's* circulating water and brine pump. This pump supplies water for the boilers and for the ship's use. It was functioning improperly and unless adequate repairs were made quickly the frigate might not make it back to its home port in Bermuda.

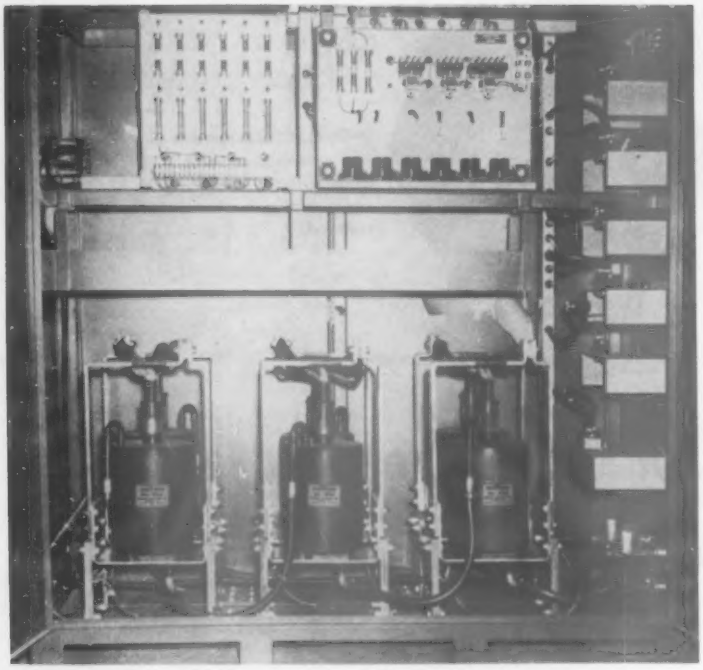
The *Ulster* contacted the U. S. Navy task force, also participating in the seaway opening ceremonies, and asked that they contact Eutectic Welding Alloys Corp. and arrange for repairs during the *Ulster's* Detroit stay.

Upon arrival at Detroit, *Ulster* was met by two company officials. They examined the pump and determined that the damaged gunmetal castings were a copper alloy containing 88% copper, 10% zinc and 2% tin.

For its repair, a tough, corrosion resistant copper-base alloy was selected. Under Eutectic supervision, a welding contractor, using portable welding equipment, did the repair.

The alloy was applied after a 700 F preheat. Finished sections were rough-ground with a portable grinder and hand-finished by crewmen.

WELDOR rebuilds eroded surfaces as Ted Schmidt of Eutectic supervises.



FREQUENCY changer resistance welder uses six size E ignitrons; is rated at 300,000 amp maximum short circuit secondary voltage.

Are you using the right size ignitron?

by **Joe S. Kirk**
and **Daniel O. Purvear**
National Electronics Inc.
Geneva, Ill.

MANY OF TODAY'S resistance welders and other a-c control applications have created greater loads than a pair of size D ignitrons can handle, thus forcing control manufacturers to parallel the ignitrons or use flip-flop circuits.

To answer welding's need for an ignitron capable of handling such heavy loads, National Electronics developed a size E (NL-1054) ignitron.

The simplicity of a circuit using a single set of back-to-back ignitrons has a marked advantage over the complications involved in either parallel tube or flip-flop circuits.

Using an internal cooling coil, a water-baffle, a water-cooled mercury pool and a large heat mass, this ignitron has more capacity than two paralleled D ignitrons.

Field tested since 1956 and providing excellent service, the E ignitron is currently being used in a wide variety of applications: single-phase welders, three-phase frequency converter welders, flash welders and special a-c control applications.

A look at one of these applications will indicate the tremendous size of the equipment using these ignitrons.

The photograph on this page is an open-door view of the contactor for a frequency changer welder, showing the size E tubes mounted. Sciaky Bros., Chicago, manufactured the entire machine; welder, control panel and contactor panel.

The machine (three-phase, 60-cycle, 600-kva) uses six of the ignitrons and is rated at 300,000 amp maximum short circuit secondary voltage. The maximum primary current is 4,775 amp for a 440 volt primary line voltage.

A typical weld for this machine uses six impulses consisting of seven heat cycles phased to 80% heat, two decay cycles and 1½ cool cycles. The primary current was measured to 3,650 amp under these welding conditions.

Tests were conducted using up to eight impulses, 20 heat cycles at 100% heat, 12 decay cycles at 55% heat and 10 cool cycles per weld. Current measured was 4,600 amp. The limitation on the number of impulses used was due to overheating of the 2½-in.-diameter water-cooled electrodes, which were short circuited during the tests.

The two factors contributing most heavily to backfires or arc-backs in ignitrons used in rectifier service are high mercury vapor pressure and high ionization density at the end of the conduction cycle.

To reduce the ionization density, ignitrons (prior to development of the size E ignitrons) use baffles without water cooling, shortening the travel distance for ions to reach a neutralizing surface. However, since these center baffles are not cooled, they run too hot in operation to control mercury vapor pressure. The size E ignitron, on the other hand, has a water-cooled baffle to aid in control of both ionization density and mercury vapor pressure.

Another unique feature is the water-cooled mercury pool. A large copper block containing water passages is solidly brazed to the tube's cathode end. Heat is conducted from the mercury pool, through the cathode wall, into the copper block and is removed by the water. This lowers the mercury pool temperature which in turn lowers the mercury vapor pressure.

The size E ignitron uses an internal water-cooled cooling coil instead of the conventional water jacket. By using a spiral-wound coil with a small space between turns, it has approximately three times the cooling surface of a plain cylinder of the same diameter.

These three—internal cooling coil, water-cooled baffle and water-cooled mercury pool—combine to produce highly efficient cooling and provide

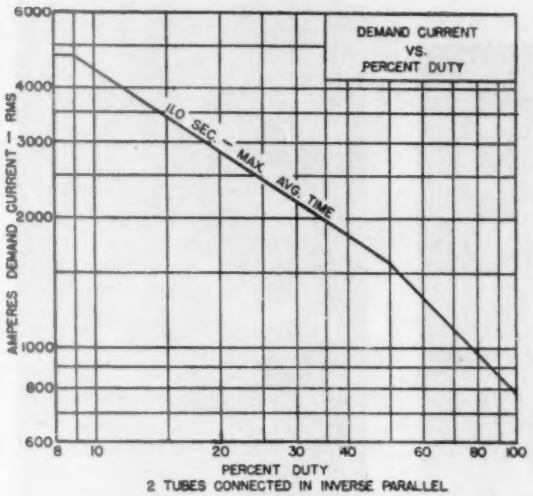


FIG. 1—500 volt a-c control rating for size D ignitrons.

exceptional mercury vapor pressure control. Thus, the size E ignitron is especially suited for high current frequency converter welders and intermittent rectifier applications where high inverse voltages and short communication times are encountered.

To reduce the power loss in the anode stud and to increase the conduction of heat from the anode, the ignitron uses a copper-cored anode stud, since copper has a much lower electrical resistance and higher heat conductivity than steel.

By coring with copper, the stud is equivalent to a steel stud of twice the diameter. Therefore, low power loss in the stud is assured and better heat conductivity is obtained for a lower anode temperature.

The size E ignitron uses a very large graphite anode. The large radiating surface of the anode and the high conductivity of the anode stud combine to give sufficient cooling to maintain a low average anode temperature, while the anode's large heat mass allows a long averaging time.

The anode's heat mass, the cooling coil and its water, the baffle and its water and the large mercury pool combine to permit 12½ second averaging time in the frequency converter resistance welder or power rectifier applications. This averaging time is 25% longer than that of the size B ignitron, and twice that of the size C and D.

With the size E ignitron it is no longer necessary to parallel D ignitrons to get high demand current, or use flip-flop controls to obtain long welder duty cycles. In many cases, they have more capacity than either of the other arrangements.

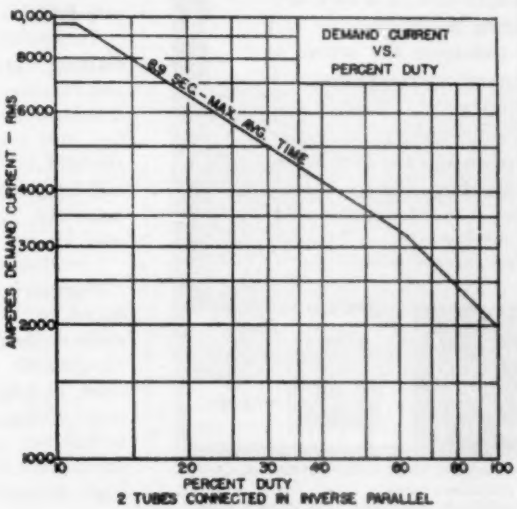


FIG. 2—500 volt a-c control rating for size E ignitrons.

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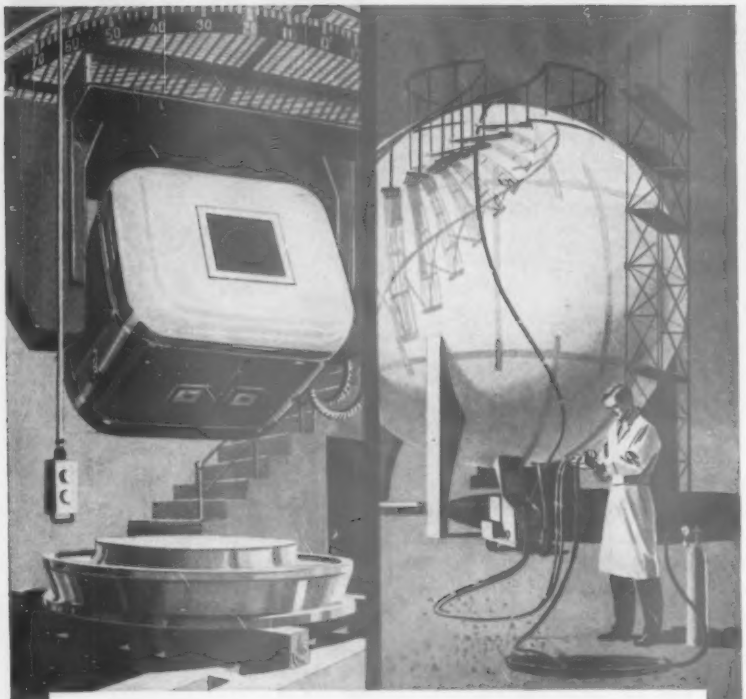

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EMERGING from cooling area at 100 fpm, tubing passes through sizing and straightening section and into cut-off area. High-speed saw on pipe-type rails can be moved to vary length of cut-off from 6-ft to any desired length.

New mill produces 4-in. tubing at 100-fpm rate

THE COMBINED ENGINEERING talents of two firms have produced a new type induction mill that turns out 4-in. diameter tubing, for use in mufflers, at the rate of more than 100 fpm.

The unit, designed by Induction Heating Corp. and Gordon & Morgan Machine Co., is 60 ft long and 8 ft high. The continuous seam welding unit used in conjunction with the mill is 50 kw, and operates at 400 kc (high frequency). The fully automatic installation can be operated by one man.

Formerly, such tubing was produced by a high-heat and slow 60 cycle method. In the new unit, approximately ⅓ less heat energy is used. This creates a narrow heat pattern, which causes virtually no deterioration on metal adjacent to the seam. Heat penetration caused by the high frequency is approximately

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1443 Grimes St. Memphis, Tenn.

0.025 at the mating surfaces.

Before, thick strip stock was necessary because excessive pressure at the weld tended to deform the tubing. The new unit exerts little pressure, so thin gage material can be used.

Operation of the mill is simple. The machine is fed low carbon steel strip stock off reels that can be adapted for continuous feeding. As the strip moves up, vertical forming rolls begin the "turn-in." Just before the strip reaches the welding station, two sets of sectionalized horizontal fin rollers start the tubing arc. The four-section rolls are used to minimize slippage, and lower driving power requirements.

A multiple-turn hair-pin type work coil induces a current that brings the abutting surfaces up to forging temperature. Next the weld is made, leaving a slight flash. Little or no finishing is required.

Immediately after welding, the tube passes through rolls which iron the weld seam, strengthening the weld zone and improving the appearance of the tube. Next, it passes into the cooling chamber where jets of water emulsion cool the weld area. From here, the tube passes into the sizing and straightening section, and finally to the cut-off station.

In this particular installation, the high-frequency welding generator converts 400 volt-60 cycle current to 400 kc. This extremely high frequency current creates molecular friction at the abutting edges of the tube, rapidly heating it to welding temperature. This method of welding works equally well with ferrous and non-ferrous metals.

CLOSEUP of work coil shows tube gap closing after passing first of two sets of fin rolls. After weld, tubing passes between second set of rolls and into cooling area at left.

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These rounded outer edges of cleaning ridges clean and polish tip orifice without scratching or cutting.

This smooth pilot guides WYPO Tip Cleaner into tip Will not enlarge or damage tip port.

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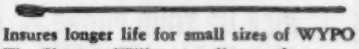

Insures longer life for small sizes of WYPO Tip Cleaners. Will not pull out of case.

NOW AVAILABLE IN 3 CONVENIENT SETS

WYPO TIP CLEANERS
STANDARD SET
CLEANER NO. | FOR DRILL
7 | 75-76
8 | 73-72-71
10 | 70-69-68
12 | 67-66-65
14 | 64-63-62-61
15 | 61-60
16 | 59-58
17 | 57
18 | 56
19 | 55
20 | 54
22 | 53-52
23 | 51
24 | 50
26 | 49
28 | 48
30 | 47
32 | 46
34 | 45
36 | 44
38 | 43
40 | 42
42 | 41
44 | 40
46 | 39
48 | 38
50 | 37
52 | 36
54 | 35-34
56 | 33-32
58 | 31-30-29
MADE IN U.S.A.
PAT. NOS. 2420581, 2473780 IN CANADA 1948
STANDARD SET OF (13) Cleans (27) Drill Sizes Nos. 75 to 49 Incl.

WYPO TIP CLEANERS
JUMBO SET
CLEANER NO. | FOR DRILL
38 | 68-67
39 | 66-65
40 | 64-63
41 | 62-61
42 | 60-59-58
43 | 57-56
44 | 55-54-53
45 | 52-51
46 | 50
MADE IN U.S.A.
PAT. NOS. 2420581, 2473780 IN CANADA 1948
JUMBO SET OF (9) Cleans (19) Drill Sizes Nos. 48 to 30 Incl.

MASTER SET
CLEANER NO. | FOR DRILL
7 | 75-74
8 | 73-72-71
10 | 70-69-68
12 | 67-66-65
14 | 64-63-62-61
15 | 61-60
16 | 59-58
17 | 57
18 | 56
19 | 55
20 | 54
22 | 53-52
23 | 51
24 | 50
26 | 49
28 | 48
30 | 47
32 | 46
34 | 45
36 | 44
38 | 43
40 | 42
42 | 41
44 | 40
46 | 39
48 | 38
50 | 37
52 | 36
54 | 35-34-33
56 | 32-31
58 | 30
WYPO TIP CLEANERS
PAT. NOS. 2420581, 2473780 IN CANADA 1948
MADE IN U.S.A.
MASTER SET OF (31) Cleans (66) Drill Sizes Nos. 75 to 30 Incl.

Replacement cleaners available. Cleaning Range —Cleaner No. & Drill Nos. stamped on back of each case. WYPO GIVES YOU MORE!

SOLD BY LEADING WELDING SUPPLY DEALERS

MAITLEN AND BENSON, INC.
1495 Obispo St., Long Beach 4, Calif.

PROTECT your acetylene cylinder investment!
Get all the facts about the

ALL NEW COYNE 92

(92% POROSITY FILLER)

ACETYLENE CYLINDER

NEW FORMULA FILLER
for higher porosity — greater capacity

NEW STRONGER STEEL SHELL
is the most durable of the industry

RIGOROUSLY FIELD TESTED
and guaranteed under all conditions

PICK UP YOUR PHONE AND CALL (COLLECT)
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SAN FRANCISCO — PLAZA 6-6910
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or write
224 Ryan Way, S. San Francisco, Calif.
155 W. Bodley Ave., Memphis, Tenn.
3900 Springdale Ave., Glenview, Ill.
24 Commerce St., Newark, N. J.

STRIPS are tack-welded to completed pipe lengths to prevent shifting of the internal pipe during shipment.

Tailored piping systems provide strength, durability

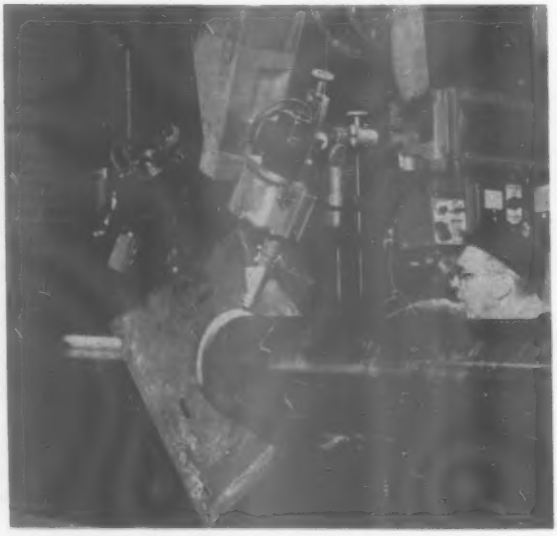
HIGH THERMAL efficiency, combined with mechanical strength and durability, is being obtained by the use of seamless steel pipe in insulated piping systems supplied by Ric-wiL, Inc., Barberton, Ohio.

The firm provides prefabricated, "tailored" pipe distribution systems consisting of a single pipe or any combination of multiple pipes for overhead or underground transmission of hot water, steam, etc. Insulated pipes are housed in asphalt-coated, galvanized conduits.

According to company officials, the decision to use seamless steel pipe is helping maintain "custom-made" quality at mass production cost levels. The pipes, manufactured by Jones & Laughlin Steel Corp., range from 6 to 14 in. in diameter; are up to 41 ft long.

Hydrostatic tests at pressures averaging 300-400 psi (and frequently as high as 600) are run on fabrication welds at the connections, elbows, tees and expansion loops called for in system designs.

Thousands of miles of the company's prefabricated piping systems have been installed in the U.S., Canada and the rest of the world. Users range from railroads and process industries to hospitals and universities.



AUTOMATIC welding plays a big role at the Ohio firm. Here a double-boom manipulator (one boom carrying a submerged-arc head, the other a Mig head) is used to weld an anchor plate to the seamless steel pipe.

News shorts . . .

Narda Ultrasonic Corp. has moved into a second building at its New Cassel site in Westbury, L. I., N. Y. The one-story, 10,000-sq-ft structure is located at 50 Sylvester St., next to the main plant. Research and development activities will be carried on . . . **Emerson Electric Mfg. Co.,** St. Louis, is expanding all the engineering activities of its electrical division.

The Buffalo district office and warehouse of the **National Cylinder Gas Div. of Chemetron Corp.** have been moved to 396 Grand Island Blvd., Tonawanda, N. Y. . . . **American Messer Corp.,** New York City, will build an air separation plant in Richmond, Calif., for **Air Reduction Pacific Co.** Daily output of plant will be 30 tons of liquid oxygen, nitrogen and argon.

Construction has started on **Pyromet Co.'s** $250,000, 22,000-sq-ft production plant and offices at San Carlos, Calif. New bell furnace with 6-ft diameter working area for dry hydrogen brazing will be included. Occupancy slated for early 1960 . . . **Avco Research and Advanced Development Div.,** Wilmington, Mass., is going to have what is said to be the country's first 150-kw radio frequency induction heater. Firm recently entered plasma torch field.

Aluminum Co. of America, Pittsburgh, is producing sheet from alloy 5456—said to be highest strength composition available in the readily weldable aluminum-magnesium alloy series. Alloy is being rolled in thicknesses ranging from 0.051 to 2 in.

Rubber & Asbestos Corp., Bloomfield, N. J., has opened midwest sales offices at 3553 W. Peterson Ave., Chicago. The firm manufactures industrial adhesives . . . Construction is about to begin on the new **R. C. Mahon Co.** $3,500,000 West Coast plant . . . The **Aluminum Smelters Research Institute,** Chicago, reports that research and advancements in the art of aluminum smelting have resulted in more than 7 billion lb of scrap aluminum being salvaged in the past decade . . . **John W. Alden, Jr.** (at left in picture), **Ordnance Div., Food Machinery & Chemical Corp.,** and **Ronald N. Skow,** district engineer for **Linde Co.,** check new liquid argon installation at FMC in San Jose, Calif. Unit will supply argon used for training weldors in fabrication of new M113 personnel carriers for Army.

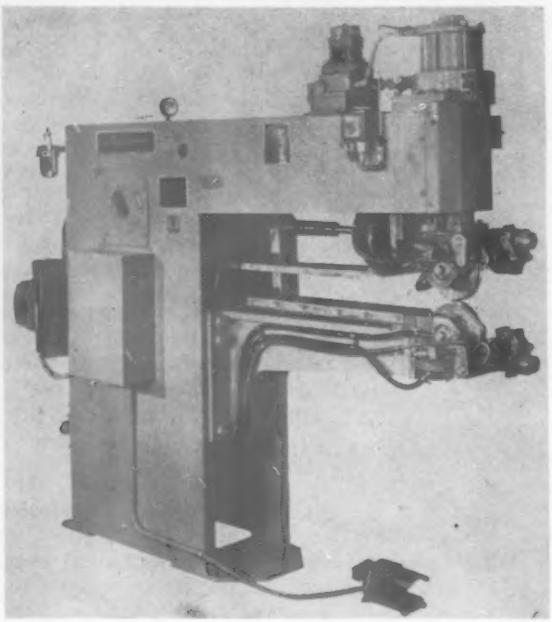
A second continuous quenching and tempering facility for the heat treatment of constructional alloy steel plate, including T-1, is being installed at the 160-in. plate mill at **United States Steel Corp.'s Homestead District Works . . .** The **Dept. of Welding Engineering, Ohio State University,** Columbus, is conducting a course in nondestructive testing this quarter.

G. A. Firestone has opened engineering consultant offices at 968 Farmington Ave., West Hartford, Conn. The firm, **G. A. Firestone Co.,** will operate several divisions . . . **American Welding Society,** in cooperation with the Div. for Continuing Education of **The University of Kansas City,** is conducting a 10-week course on "Welding applied to structural design and fabrication."

The first atomic-powered merchant ship, the **N. S. Savannah** (See "Welding helps launch first nuclear-powered merchant ship," **WE** September, p. 50.) contains 23 tons of steel floor plate. Plate was designed to aid safety, and has pattern of raised diamond-shaped "grips." **Alan Wood Steel Co.,** Conshohocken, Pa., designed and supplied material.

Robert S. Lynch, former chairman of **Atlantic Steel Co.,** has joined **Frank F. Ford Associates,** manufacturers' representatives for welding supplies and other equipment, to form **Ford-Lynch Associates.** Offices are at 1015 Chattahoochee Ave. N. W., Atlanta, Ga.

new products . . . . . use card on page 105



Portable X-ray

X-ray equipment weighs only 46¼ pounds and ships in shock-proof case measuring 26 by 24 by 18-in. The novice can master controls with a few minutes instruction, claims manufacturer. Radiographs with 2% sensitivity and 1.5 density can be produced with 1½ minute exposure through 1¼-in. steel, and a continuous range of 70 to 140 kvp is available. *X-ray Dept. General Electric Co.*

Circle No. 1

Temperature indicators

Additions to line meet need for indicators in high temperature ranges. Tempilap and Tempilstiks, temperature indicating brush-on liquid and crayons, are available for 2300, 2400 and 2500 F. These additions bring to 80 the company's line of indicators. *Tempil Corp.*

Circle No. 2

Gas-oxygen burner

Swivelhead surfacemix burner is so named because heads may be swiveled on holder. Provided with three heads—two round and a rectangular for ribbon-style fire—the burner does not flash back. It operates on the usual fuel gases supplied in a wide range of pressures, says manufacturer. *Bethlehem Apparatus Co., Inc.*

Circle No. 3

Welding head manipulator

"Robot" mechanized welding head manipulator features simultaneous boom, carriage column and base travel for automatic welding. For floating operation, the heads are mechanically controlled, either singly or together, along the boom and up to 12 inches vertically. Heads, base and column are pendant controlled. *The World Electric Co.*

Circle No. 4

Hand scarfing torch

Oxweld C-65 scarfing torch operates on either acetylene or fuel gas. Equipped with starting rod feed and spring-loaded anti-flashback floating gas mixer, the unit also features shorter nozzles for increased rigidity and longer life. The torch produces a broader low velocity oxygen stream, increasing the width of scarfing area in a single pass. *Linde Co.*

Circle No. 5

Projection welder

Projection welder has "Heat-Vector" for automatic control of up and down slope of welding current, providing exact heat cycle needed to produce strongest welds, says manufacturer. Features also include non-binding ram action and easy manual positioning of ram wearing surface, for long life and little downtime. *Universal Electroweld Div.*

Circle No. 6

Silver brazing flux

Kwikflux 490 has greater heat tolerance and better coverage per pound, states manufacturer. The flux will remain in solution and retains its strength when diluted with relatively large volumes of water, and its smooth consistency makes use possible in automatic operations. *Special Chemicals Corp.*

Circle No. 7

Seam welder

Trim-line seam welders are offered in three sizes ranging from 50 to 400 KVA, and in a choice of circular, longitudinal or universal in standard throat depths and transformer sizes. Features of these machines include one-piece frame, anti-friction slide, and new lower arm and transformer design. *The Federal Machine and Welder Co.*

Circle No. 8

Portable a-c welder

Welding machines available in 90-180 and 295 amp sizes are especially suited for farm welding jobs. Equipped with wheels, double glass insulated copper coils, these welders cut and weld most metal sizes and, with addition of AT-1 twin carbon arc torch, will solder, braze and heat. *Emerson Electric Mfg. Co.*

Circle No. 9

Surface protection compound

Protection compound for stress relieving and arc-air process adheres to surface under air blast. Applied with paint brush, Protex is especially recommended for use on stainless steel and machined surfaces. It also prevents scale during heat-treat or stress-relieve operation. *The Arcair Co.*

Circle No. 10

Tantalum tubing

Thin-walled welded tantalum tubing is now sold by the foot as a stock item. Hydrostatically tested at 250 psi, the tubing comes in standard sizes of 1, 1½ and 2-in. OD, with .010, .013, .015 and .020-in. wall thicknesses. *Haynes Stellite Co.*

Circle No. 11

Speaking of "*Pencils*"...Look what's happened to the TEC Pencil Torch!...

Sounds unbelievable, but TEC'S done it again! Developed an off-set transparent Gas Nozzle and a "non-slip" off-set chuck which converts the famous TEC Pencil Grip Torch into a miniature 300 Amp 45° or 90° Angle Torch in seconds! . . . And WELDS IN 1½ INCHES OF SPACE!

NOW WELD IN NORMALLY INACCESSIBLE AREAS WITH THOSE FAMOUS TEC FEATURES:

"TIP-OF-THE-TORCH" COOLING SO YOU WELD CONTINUOUSLY AT 300 AMPS!
Continuous coolant water reaching the tip of the torch affords cool, continuous welding at 300 amps.

GUARANTEED GAS AND WATER LEAKPROOF!
One-piece unit torch head without threaded fittings or gaskets to wear or leak eliminates gas and water leakage.

UNPARALLELED MANEUVERABILITY!
Lightest weight, only 3 ounces, fine balance and miniature head mean exceptional handling in only 1½ inches of space.

MAINTENANCE ELIMINATED!
Simplicity of design with no moving parts eliminates replacement parts. Quality workmanship assures years of service.

Off-set Nozzle
Off-set Chuck
A durable, Vycor nozzle, transparent so you SEE WHAT YOU WELD coupled with an easy adjusting "non-slip" chuck.

SPECIFICATIONS

OVERALL LENGTH— 8¼ in. with 45° Nozzle 8 in. with 90° Nozzle	WORK RANGE— 3 to 300 Amps Continuous Cycle
WORKING WEIGHT— 3 ounces	HANDLE DIAMETER— 1 inch
HOSE LENGTH— 12½ feet	EXTRA LENGTH AVAILABLE 25 feet

NOZZLE SUPPLIED — 45° or 90°, Vycor, 3 in. orfice extension available

Contact your local distributor or write direct:

TEC

TEC TORCH COMPANY, INC., CARLSTADT, N. J.
MANUFACTURERS OF VISUWELD EQUIPMENT

KNOWING what you will need IS HIS BUSINESS

Your LINDE Distributor is an independent local businessman who concentrates on knowing what you are going to want and on having it ready for you. He's a welding specialist, too, with wide practical experience and intimate knowledge of local industry. Knowing is part of his job. Maintaining adequate stocks for immediate delivery is another.

So your LINDE Distributor carries a complete line of welding and cutting equipment, industrial gases, welding rods, and supplies. He handles high-quality products of proved efficiency and recommends processes and methods best suited to your needs. His resources, plus the benefits of LINDE's 50-odd years as a leader in welding and cutting, are as near to you as your telephone.

Talk to your LINDE distributor today. Get to know him better. If you can't find his name in your telephone directory, write to: Dept. 311, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd St., New York 17, N. Y. *In Canada:* Linde Company, Division of Union Carbide Canada Limited, Toronto.

Linde

UNION CARBIDE

"Linde" and "Union Carbide" are registered trade marks of Union Carbide Corporation.

Induction coil coating

Kotacoil prevents chemical deterioration, such as erosion from fluxes, and reduces possibility of arcing on induction coils. The coating is sprayed on the sand-blasted parts, which are then air-dried and baked. *Induction Heating Corp.*

Circle No. 12

Safety spectacle

Varifit bridge gives name to line of safety spectacles. Proportioned to eye size of the frame in a way that permits correct fitting on most employees, the spectacle also features eye-wire which firmly locks lens in place. Varifit is available with hardened glass or plastic safety lenses, in plain or prescription. *United States Safety Service Co.*

Circle No. 13

Induction voltage regulator

Rack-mounted Inductrol voltage regulator handles loads to 8.5 KVA and 100 amp. Available automatic or motor driven, the regulator features no brushes, introduces no harmful wave form distortion and has drift-free controls which maintain ±1% bandwidth accuracy. *General Electric Co.*

Circle No. 14

Hinged closure unit

Hinged closure for use in vacuum and high pressure service is available in unit consisting basically of hub installed with single circumferential weld, and hinged cap clamped within two yoke halves. Available in sizes from 2 to 42-in., for ASA 140, 300 and 600-lb service, units 8-in. and larger are furnished with two yoke bolts that spread yokes simultaneously. *Tube Turns Div.*

Circle No. 15

Punch press

Bt-8 eight ton punch press fills gap in company line. Available with 8½-in. shunt height and 10-in. throat, the press will permit work on parts which previously required larger machines, says manufacturer. Available either as bench or floor model, stroke is 1½-in., with special strokes of ¼ to 3-in. available. *Alva Allen Industries.*

Circle No. 16

Hard aluminum alloys

Aluminum castings and forgings, with precision-welded zone of super-hardness, retain this property at very high temperatures. One of the four new alloys being tested provides Brinell hardness of 250 at room temperature and unusual hardness at elevated temperatures. *Aluminum Co. of America.*

Circle No. 17

Horsepower nomogram

Dual nomogram for hp, torque and rpm is applicable to fractional hp motors and transmissions. Offered as an 8½ by 11-in. data sheet, the rpm scale reads from .5 to 500, and torques, to 600 lb.-in. *Merkle-Korff Gear Co.*

Circle No. 18

Metallizing gun

Heavy-duty automatic metallizing gun features two-position air cap that automatically adjusts itself. Called the Adjustomatic, the gun handles wire from 15 B&S to 3/16-in. and in feeds ranging up to 23.1 fpm. It has dual powered wire feed rolls and removable tungsten nozzle wire inserts. *SpraRod Corp.*

Circle No. 19

Industrial silicon rectifiers

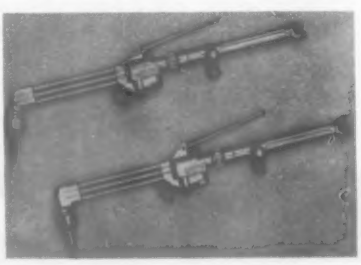
Two-hundred-fifty volt d-c silicon rectifiers are available for either heavy-duty applications or for general purpose use. The heavy duty models come in ratings of 400 to 2000 kw. The 150-300 kw general purpose machines are for three-phase, 60 cycle primary voltages of 208, 240, 480 and or 600. Both rectifier lines have 95% efficiency in the 25 to 100 percent load range. Operation is quiet with all instruments fully visible. *Allis-Chalmers Mfg. Co.*

Circle No. 20

Cutting assembly

Airline 300 cutting assembly permits use of MC 6-hole series of Slip-In tips. Model AC305, with 75 deg head, and AC309, with 90 deg, are both pressure forged of dense brass with "O" ring seals keeping gas separated. Capable of cutting steel up to 1½-in., both models are 8¾-in. long and weigh 17¾ oz. *Smith Welding Equipment Corp.*

Circle No. 21



Shearing and cutting machine

Model TE-100 Mellmastr is bench model machine with edge-cutting capacity of up to 12 gage mild steel and 16 gage stainless. Cutting speed is from 8 to 15 fpm; strokes per minute are automatically regulated by material thickness when operator sets stroke pointer. Stroke is adjustable from .022 through .110. *Lennox Tool and Machine Builders.*

Circle No. 22

Passivating bright dip

Copper-Brite, a passivating bright dip for various metals, is claimed to leave no residue that will interfere with conductivity after clear water rinse. Non-toxic, non-fuming and requiring no special ventilation, Copper-Brite is available in one gallon bottles and thirteen gallon car-boys. *Rossaul Co.*

Circle No. 23

Metal cutting nibblers

Nibblers, available either electric or pneumatic, cut up to 10 gage stainless steel or 8 gage mild without distortion. Weighing from 8 to 13 lb., the punch-and-die action nibblers cut copper, brass and aluminum and, with special attachments, other material at speeds of five fpm. *Fenway Machine Co.*

Circle No. 24

Solenoid valve

Filterlock Model FL-215 solenoid valve, for use with LP-gas carburetion, is a combination of both filter and solenoid. Only 2⅞-in. long, the 8 oz. FL-215 is available in either 6 or 12 v. It is suitable for installations using up to 4 gallons of liquid per hour. *Beam Products Mfg. Co.*

Circle No. 25

Roll finishing machine

Roll finisher using octagonal-shaped barrels is designed for precision finishing of small parts, such as screws, washers and delicate gears. The barrels, made of neoprene with steel-reinforcing and a sheet steel end door, are placed on rollers powered by a one-half hp 110-v drive motor. Available in eight models, the largest machines will process eight barrels simultaneously. *Techline Div. Wheelabrator Corp.*

Circle No. 26

VALUE VERSATILITY

...you get more of both in the

PUROX
TRADE MARK
"E" Cutting Torch

When LINDE first offered the PUROX "E" Torch to industry, Ford's model T automobile sold for less than $500. Today's average car costs at least 350% more. *But the price of the "E" torch has gone up only 22%.* Since practically every part in it has been refined for improved performance and longer life, the PUROX "E"—granddaddy of cutting torches—is still one of the biggest oxy-acetylene apparatus values to be found anywhere.

Whatever your present requirements, there's a PUROX "E" Torch to take care of them. Choose a head angle of 75, 90, or 180 degrees in standard 20½-in. length, or a 36-in. model with 90-deg. head. Should new or special needs develop at any time, any model can be adapted to meet them by simply replacing the front-end assembly.

With four interchangeable front ends and 57 different nozzles, the PUROX "E" Torch easily handles any practical hand-cutting job. It cuts steel up to 12 in. thick, washes pads, cuts rivets, gouges, and pierces. *And it performs efficiently on acetylene or any other commercial fuel gas available.*

See the PUROX "E" Torch today at your LINDE Distributor's. Or write for free folder, F-1313. LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. *In Canada:* Linde Company, Division of Union Carbide Canada Limited, Toronto.

Linde Trade Mark

UNION CARBIDE

The terms "Linde," "Purox," and "Union Carbide" are registered trade marks of Union Carbide Corporation.

Job report courtesy of
Electric Steel Foundry Company, Portland, Oregon

When nuclear applications call for stainless welds of highest quality

WELD WITH ARCOS

STAINLESS ELECTRODES

This is part of a 3900 lb. stainless pump-volute casting for a submarine nuclear power plant. In the photo, a skirt is being welded to the casting using 5/32" dia. Arcos Chromend K Electrodes. To minimize stresses, a step-back and skip procedure was used. These welds conformed to Class I Navy radiographic standards—an indication of the dependability of standard Arcos electrodes for your stainless welding needs. ARCOS CORPORATION, 1500 South 50th St., Philadelphia 43, Pa.

Flux grinder

Submerged melt welding flux grinder processes over 1500 lb. of flux per hour. Equipped with a dust suppressor, magnetic separator and self-cleaning screen, both roll crushers of the unit are powered by a totally enclosed 3 hp motor. *L & B Welding Equipment, Inc.*

Circle No. 27

Liquid oxygen manifold

Oxweld M-40 manifold, when used with four LC-3 cylinders, provides 12,000 cu. ft. of oxygen in uninterrupted supply. The unit features compactness and automatic change-over from one bank to another as supply is depleted. Also available is the M-40-2 two cylinder manifold. *Linde Co.*

Circle No. 28

Flexible etched circuitry

Custom-designed circuitry is embedded between two sheets of thermo-plastic, fused together for protection against environmental hazards. The circuitry offers maximum flexibility, minimum assembly time and uniform electrical properties, says manufacturer. *International Resistance Co.*

Circle No. 29

Tube bender

All steel Tubela Bender develops eight tons of pressure through manual hydraulic pump to bend 2-in. extra heavy steel pipe. Available with six sets of bending dies in sizes from ½ to 2-in., the bender comes with a straightening shoe in a strong metal case. *Wallace Supplies Mfg. Co.*

Circle No. 30

Magnetic separator

Model 3550 is compact, economical separator using neoprene vulcanized endless belts. The ferrous parts are lifted from media by magnet located above cleated parts belt in 11-in. long separation area. Belts, pulleys and magnets are adjustable to regulate tension for handling various parts. Also available is demagnetizing device. *Techline Div. Wheelabrator Corp.*

Circle No. 31

H-f induction heater

Induction heater operates at 120,000,000 cycles per second for heating highly resistive conductors, such as silicon, boron, titanium boride and others. Special features include speed, special localization of heat and adaptability to production line, since no water cooling of work coil is required. The induction/dielectric heater is available in 1 and 5 kw ratings. *Radio Frequency Co., Inc.*

Circle No. 32

Output generator

Model 150, a 114. BTU per minute generator with 2 kw output, has nominal frequency rating of 450 kc. Featuring two position transfer switch, the power input of the generator is 220 volt a-c, 60 cycles single phase. Unit also incorporates automatic timer which may be preset. *Induction Heating Corp.*

Circle No. 33

High vacuum pumps

Series 1400 packaged pumping systems are for high vacuum work. The three pumps in the 2 to 6-in. range are caster mounted, while the three 10 to 32-in. units are complete skid-mounted assemblies. Diffusion pumps used have mechanically refrigerated or liquid-nitrogen cooled traps. *General Vacuum Corp.*

Circle No. 34

Welded steel tubing

Lectrosonic welded steel tubing performs better than seamless carbon steel tubing in heat exchanger applications, claims manufacturer. Manufactured under integrated quality control, the tubing is said to afford important savings. *The Babcock & Wilcox Co.*

Circle No. 35

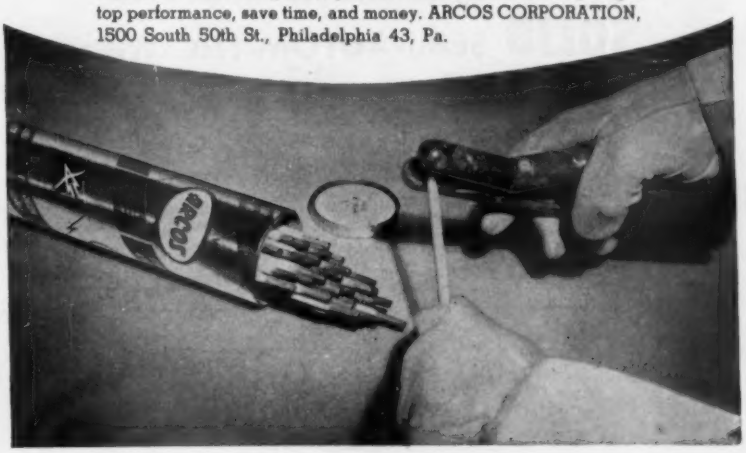
Job Report Courtesy of
Southwest Welding & Mfg. Division,
Yuba Consolidated Industries, Inc., Alhambra, Calif.

When strong welds are needed to resist impact at minus 320°F

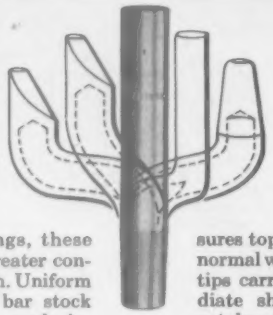
WELD WITH ARCOS

STAINLESS ELECTRODES

This six-section spherical liquid oxygen container is made of Type 321 stainless steel. Walls 4½" thick were required to withstand 3000 psi pressure. To assure crack-free welds to meet ASME impact properties at −320°F, it was welded with Arcos Chromend 19/9Cb-LC electrodes with controlled ferrite. The first time—and every time you use Arcos electrodes—you get top performance, save time, and money. ARCOS CORPORATION, 1500 South 50th St., Philadelphia 43, Pa.



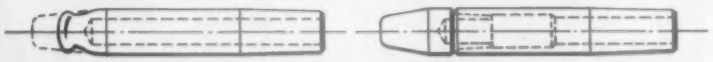
Are You Yet Using Cast Tips?



TUFFALOY
Cold-Formed Tips Are The Answer

Compared to castings, these Tuffaloy tips show greater conductivity and strength. Uniform high quality of the bar stock from which they are made insures top performance under all normal welding pressures. Many tips carried in stock for immediate shipment. See Tuffaloy catalog for this wide selection.

TUFFALOY® Spotwelding Tips



Are You Throwing Away 90% of Worn, Mushroomed Tips?

With Tuffcap®, You Replace Small Tip only, Re-use Shank

With care Tuffcap shanks outlast many Tuffcap tips, interchangeable in four standard nose designs. Tips are easily replaced, reducing holder wear and down-time of machine.

Tuffaloy resistance welding alloy products are widely available through Airco and Tuffaloy representatives. Call on them for SPOTWELDING TIPS (Standard, 'Tuffcap', Cold-Bent, and Special), Holders and Adapters, BAR STOCK, FORGINGS, SEAM WELDING WHEELS, and all other welding alloy needs. Ask for Catalog and Price List.

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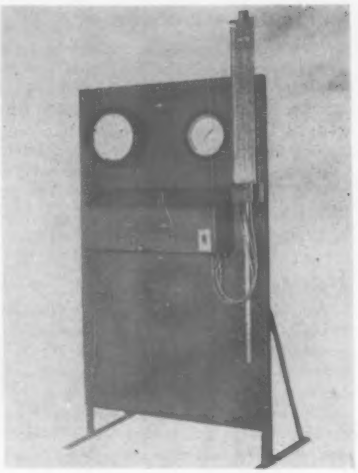

Multiple burette holder

Burette holder is companion piece for hydrostatic gas cylinder tester. The holder carries three glass measuring burettes of different sizes so that cylinders of various sizes may be tested. *Independent Engineering Co.*

Circle No. 36

Acceleration switch

Series 5 I-S acceleration switch is responsive to axial acceleration, uni- and bi-directionally, from 5 to 50 g. Its actuating time is 20 milli-seconds, with accuracy within 5%. Only moving part is precision ground ball held by uniform magnetic field, which opens or closes circuit when acceleration becomes strong enough to release it. *Inertia Switch, Inc.*

Circle No. 37

Bonding material

Narmtape 105 is easy-to-handle bonding material of cotton cloth and partially-cured phenolic resin, with adhesion produced by application of heat and pressure. The material is especially suited for honeycomb core materials such as aluminum, paper and fiberglass. It is available in rolls of 36 to 52-in. widths, and has an uncured thickness of .007 inches. *Narmco Resins & Coatings Co.*

Circle No. 38

Electrode holder

Series ST holder features mechanical cable connection. Connection nut, which terminates in silver-plated point, is threaded into lower tong. As nut is tightened, stripped cable strands are equally spread around point and are held snugly against interior insulation. Said to allow neither strain on cable strands nor peel-back of jacket, the unit is available to fit cables No. 1, 1/0, 2/0 and 3/0. *Jackson Products.*

Circle No. 39

Swivel jaw vise

Vise to hold tapered or irregular work pieces is available in jaw widths of 3½, 4½ and 6-in. Tapering locking pin holds rear jaw parallel with front jaw for straight clamping; with locking pin removed, rear jaw will traverse arc of 120 deg. *Wilton Tool Mfg. Co., Inc.*

Circle No. 40

Goblet finishing buff

Toughness and endurance combined with gentle surfacing action are advantages claimed for new low-cost goblet finishing buff for metal finishing. Ray Buf Style 154 uses liquid or solid polishing compounds and does not spray compound off work surface. Made of springy dense wool fibers mounted on a solid polishing hemispheric core, this non-clogging brush comes in sizes from 4 to 8-in. in diameter. *Schlegel Mfg. Co.*

Circle No. 41

Wet blasting abrasive

Liquasheen consists of uniformly round glass beads which impart silvery sheen to parts cleaned and finished. Abrasive is resistant to fingerprinting on non-ferrous parts, resists water staining in drying of parts and does not flower or highlight. Liquasheen has life of 40 to 50 hours actual blasting time, says manufacturer. *Techline Div. Wheelabrator Corp.*

Circle No. 42

Auto crane

Crane, powered with direct current, high torque, reversible motors and controlled by portable pendant-type control station, is easily mounted on any automotive vehicle. Drawing power from the vehicle battery, the unit features automatic braking, controlled spooling of cable and a light weight telescoping boom capable of 360 deg rotation. Models will handle up to 5,000 lb at 80 deg to the horizontal. *Auto Crane Co.*

Circle No. 43

Rust preventative

Anarust rust-preventive additives and compounds are used principally in wet blasting abrasive slurry. Types B and C leave film on part, protecting it from rust caused by air or moisture. Types D and S are water-displacing, the former a dip and the latter, for spraying operations. *Techline Div. Wheelabrator Corp.*

Circle No. 44

Portable engine generator

Winco Lite a-c generator is rated at 2500 watts but develops up to 3000 W intermittent power. Weighing 123 lb., the generator has three receptacles of different types. A duplex outlet offers full power at either 115 v or 230 v. Besides carrying handle, Winco Lite is offered with stationary base, 2-wheel dolly or carrying cradle. *Wincharger Corp.*

Circle No. 45

Air-operated marking tool

Tool is used for engraving parts numbers or marking in general manufacturing operations. Thumb screw regulates proper frequency of blows and desired depth of cut from tool's carbide cutting tip. The 9 oz. unit is 7¾-in. long, and is furnished with air regulator, eight feet of hose and pipe thread fittings. *Thor Power Tool Co.*

Circle No. 46

Sweep frequency generator

Model SG-1R sweep frequency generator is used for rapid analysis of tape and disc recorder and pickup frequency responses. Amplitude vs. frequency is automatically displayed on specially calibrated CRT screen of oscilloscope. SC-1R combines swept signal output with synchronizing pulse for making test records. *Panoramic Radio Products, Inc.*

Circle No. 47

This on-the-job test reports:

"Cooler . . . lasts 3 times as long"

Spot Welder No. 89

Service Welder No. 199

Welder's Mitten No. 98

Riegel

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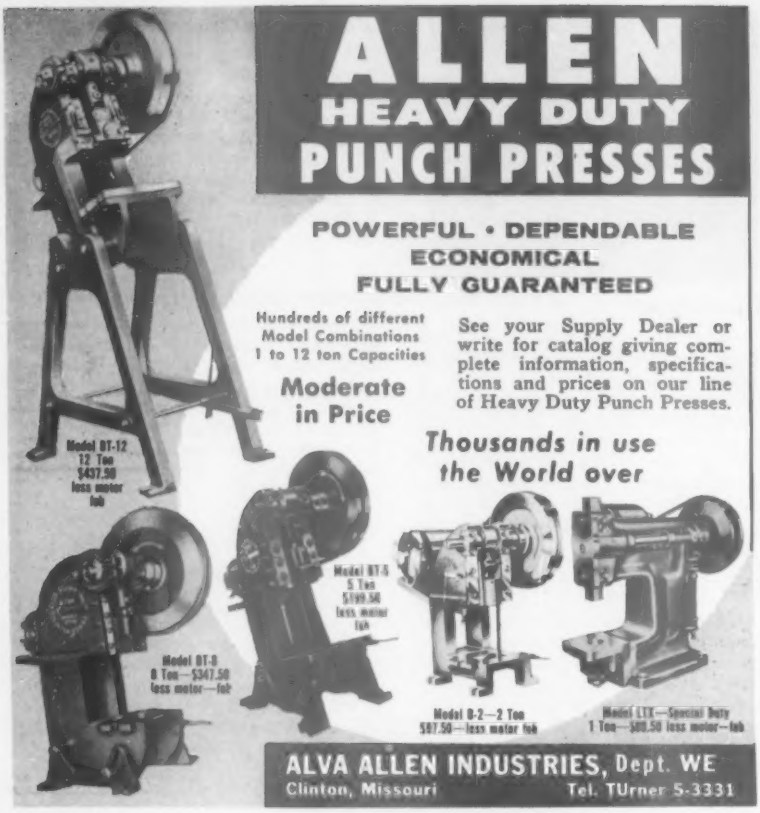

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Flame-cutting table

Table uses cast iron cones to support workpiece. The air space between plate and table dissipates the intensity of heat reaching table, and cone damage is minimized by wide spacing. Table top sizes are 80 by 87-in. and 81 by 63-in. *The Cleveland Crane & Engrg. Co.*

Circle No. 48

Barrel finishing medium

Jetforms is natural alumina-silica medium for use in barrel finishing operations which presently use aluminum oxide, quartz or limestone. Non-porous and very dense, it imparts a fine matte finish. Jetforms is available in 16 sizes, ranging from 00 to 14. *Techline Div. Wheelabrator Corp.*

Circle No. 49

Three-way solenoid valve

Series L3 are high-flow, three-way solenoid valves for general industrial use. Introduced in orifice sizes of ⅜, ½ and ¾-in., these valves operate on a pressure differential of from 5 to 150 psi. The bodies are of naval forged brass with internal parts of stainless steel and brass. *Skinner Electric Valve Div.*

Circle No. 50

Open center vise

Po-Ko-No is a heavy-duty vise with no obstruction beneath jaws. A quick-change devise maintains jaws at predetermined position, releasing or clamping by flick of cam lever. Offered are 3-in. jaws with maximum opening of five inches; 5-in., with nine incn opening; and 6-in., with ten inch maximum. *Stroudsburg Engine Works, Inc.*

Circle No. 51

Welding cable connection

Threaded power connection (T.P.C.) is new method of connecting welding cable to accessories. One end of a soft copper sleeve is threaded, and bared end of the cable is crimped into other end of the sleeve. This assembly is then screwed into socket on accessory, making the electrical connection. *Lenco, Inc.*

Circle No. 52

Welding helmet

Fiberglass reinforced plastic helmet has straight front for better ventilation and chest protection. Model 1210 has fixed lens holder molded into shell to eliminate possible light leaks. This helmet is available in six colors; also available in gray only is Model 1211 with a lift front lens. *Hobart Bros. Co.*

Circle No. 53

Battery voltage regulator

Battery voltage regulator of transistorized magnetic amplifier type provides constant output for electronic circuits. The completely solid state device maintains outputs to 2%, even when battery supply voltage drops 20 to 30%. Regulator is maintenance free and will operate in adverse environments. *Gulton Industries, Inc.*

Circle No. 54

Welding and cutting outfit

Welding outfit may be purchased with or without accessories, such as hose, goggles or lighter. Equipped with attachments capable of cutting 4-in. metal, the outfit also contains only nozzles types which will fit, with appropriate mixers, the company's larger welding torches. *National Welding Equipment Co.*

Circle No. 55

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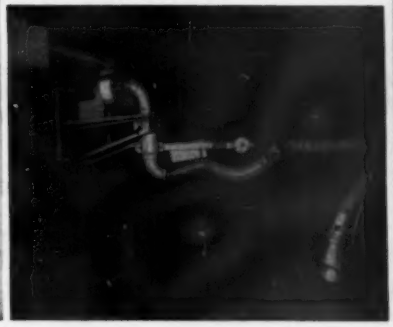

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A perfect paint base. No stirring or dilution necessary. No grinding after welding—spatter can be wiped away with a dry cloth.

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Available in 1 gallon cans and 5 gallon cans and 55 gallon drums.

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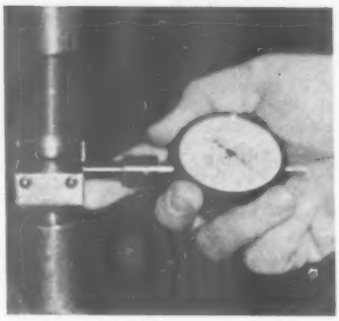
Softie goggle includes vinyl noseguard and six splash-proof vents to give wearer maximum protection against chemicals. Available in color-coded yellow, Softie has wide-angled lens of .050 acid resistant plastic and an easily adjustable neoprene rubber headband. *Glendale Optical Co.*

Circle No. 56



Electrode pressure gage

Gage measures electrode pressure in resistance welding equipment. Reading to 2,500 psi, the gage is 5⅛-in. thick between load application points. Accuracy is ±4%, and the gage is calibrated against precision standards. In multiple gun press welders, the pressures of several load cells can be read with one dial indicator. *Instrument Control Co.*

Circle No. 57

Portable exhaust system

Exhaust system is designed to remove welding and soldering fumes. Mounted on rubber-wheeled truck, system features magnet-base exhaust inlet to hold fast near or on workpart. *Car-Mon Products, Inc.*

Circle No. 58

About people . . .

Duncan

Bartz

Sherwood

Buchanan

C. Blaine Duncan has been named general sales manager of Sight Feed Generator Co., West Alexandria, Ohio. He will be in charge of the entire sales program, domestic and export.

Ed Bartz has been appointed sales manager of Airline Welding & Engineering, Hawthorne, Calif. He will be in charge of positioning and roll planishing equipment.

Robert F. Fox is now national sales manager for Eutectic Welding Alloys Corp., Flushing, N. Y. Assisting him in forming a new sales program will be a newly organized sales management team.

Dorsey L. Lawrence has been named assistant district manager in Milwaukee by the National Cylinder Gas Div. of Chemetron Corp., Chicago.

Carl B. Wille, former director of engineering for Carborundum Co., Niagara Falls, N. Y., has been named general manager of the company's Curtis Machine Div. He succeeds *Gene DeMambro* who resigned to pursue other business interests.

United Specialties Inc., El Dorado, Ark., has named three new sales representatives: *E. R. Laden*, Ft. Wayne, Ind.; *Nick H. Dosker, Jr.*, Louisville, Ky.; and *George T. Oberklein and Associates*, Cincinnati.

John M. Gleeson has been elected vice president of Picker X-Ray Corp., White Plains, N. Y.

Jack Thesenga has been appointed factory sales representative for Sellstrom Mfg. Co., Palatine, Ill. He will cover Colorado, Kansas, Nebraska, Wyoming, Montana, North and South Dakota, and some Canadian provinces.

Richard L. Sherwood has retired from Hobart Bros. Co., Troy, Ohio, after 16 years of service. He was territorial manager, a position now filled by *Robert K. Buchanan*, former eastern district manager.

The Receiving Tube Dept. of General Electric Corp., Owensboro, Ky., has created a new position—severe environment specialist—to be filled by *John R. Crittenden*. He will provide information on difficult environments in which electronic equipment must operate, and interpret tube specifications.

Richard L. Haligas is the new midwestern district manager for Carol Cable Co., Pawtucket, Rhode Island. He will headquarter in Glen Ellyn, Ill.

The responsibilities of *E. O. Williams*, vice president and director of Victor Equipment Co., San Francisco, now include overall supervision of the entire southwestern district. *F. V. McGinley*, former assistant branch manager, has been appointed branch manager in Los Angeles, and assistant manager in the southwest sales division.

Merwin B. Clapp, formerly of Chicago Bridge & Iron Co.'s general sales staff, has been transferred to the company's Chicago district office as a contracting engineer.

Jacob B. Taylor has been elected executive vice president-finance, and *Leon C. Guest, Jr.*, has been elected vice president and controller of General Telephone & Electronics Corp., New York City.

Edward J. D'Amore is the new service sales manager for the Brazing & Wire Divisions of United Wire & Supply Corp., Providence, R. I.

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Here, complete in one volume, are all welding fundamentals and practical working techniques—arranged alphabetically for speedy reference.

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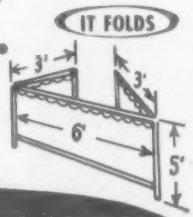

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Gudman

Kuhlmann

Industrial Air Products Co., Portland, Ore., named two executives to the position of vice president. *M. A. (Mike) Gudman* is now vice president-comptroller, and *Kurt Kuhlmann* is director of all company production.

The Joint Chiefs of Staff have selected *Robert G. LeTourneau*, of R. G. LeTourneau Inc., Longview, Tex., to receive the 1959 National Defense Transportation Association's Award. The award, to be presented Oct. 14, names LeTourneau as the person "whose achievement contributed most to the effectiveness of the transportation industry in support of national security." He developed an electric wheel system for powering ultra-heavy-duty equipment.

W. A. Taylor, Canadian Industries Ltd., is now responsible for the functioning of the Canadian Section of the Compressed Gas Association Inc., and is serving as acting chairman. He took over when *David Black*, British Oxygen Canada Ltd., and chairman of the section, was recalled to England by his firm.

Now vice president in charge of manufacturing for the entire company, *Samuel R. Parry* was previously vice president and general manager of Chattanooga Div., Combustion Engineering Inc., New York City. He has appointed *Harry J. Bolwell* as general manager of Chattanooga Div., largest of the firm's domestic manufacturing plants.

H. C. Meyer, Jr. has been named general manager of a new department, Market Research and Control, at Foote Mineral Co., Philadelphia. Foote Mineral has also promoted two men in sales. *Boyd E. Cass* was named general sales manager; he had previously served as manager of metallurgical sales. *Anthony C. Demos*, formerly sales engineer with Foote, has been promoted to manager of metallurgical sales.

Raymond T. Klempay has been appointed vice president, engineering, of the McKay Machine Co., Youngstown, Ohio. He will remain as vice president and general manager of Metal Processing Machine Co., a McKay subsidiary. In 1952 Klempay had the idea for the shear welder, a machine designed for butt-welding sheets or strips of metal end-to-end. He attended Youngstown University and Carnegie Institute of Technology.

Mingo Oxygen Co., Mingo, Ohio, has elected *Edwin H. Johnson*, president; *Russell J. MacMullan*, vice president; *L. Woodward Franzheim*, vice president and treasurer; *J. Gordon Hutchinson*, vice president and comptroller; and *Harry R. Hesse*, secretary.

Dr. Arthur G. Metcalf is now assistant director of research, Solar Aircraft Co., San Diego, Calif. Prior to joining Solar he was supervisor of physical metallurgy, Armour Research Foundation, Chicago.

Great Lakes Fabricators Association recently appointed *J. K. McEvoy* executive secretary. He had formerly been sales manager of Unit Steel Co.

Died . . .

Wall

Albert F. Wall, chairman of the board of Wall Colmonoy Corp., Detroit, died Aug. 3 at 68. Mr. Wall was also president of Wall Colmonoy Ltd., Canada, and Wall Gases. He was founder of Wall Bros., Wall Bros. Oxygen Co., Diamonds and Tools, Inc., and Wall Chemicals.

Edward J. Finnegan, Flushing, N. Y., the traffic manager of the Metals Div., Olin Mathieson Chemical Corp., died of a heart attack August 26. He was 53 years old.

James Coleman, planning and services manager for Amperex Electronic Corp., Hicksville, Long Island, N. Y., has died at the age of 64. He was at one time with Westinghouse Electric Mfg. Co., and North American Philips Co.

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Put this "one-man pipe shop" to work in your plant

Produces straight or beveled cut-offs, saddle and insert type tee intersections, lateral intersections and miters. Extremely simple to operate. Pipe is laid on rollers. The horizontal reciprocating movement of the cutting torch is automatically guided and synchronized with the rotation of the pipe to produce the contour of the cut desired. Used by oil refineries, constructors, pipe fabricators, aircraft companies, tank manufacturers, etc.

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- Handles any length pipe.
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- No hand trimming—cuts are smoothly finished and beveled.
- Makes uniform cuts on production runs.
- Two models available—Model C (shown)—handles pipe from 2" to 24" diam. Model G for pipe up to 42" O.D.

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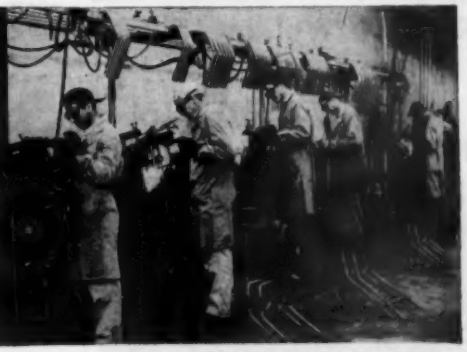
TOP QUALITY **FLUXES** made by All-State for WELDING BRAZING SOLDERING



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At ALL-STATE each flux is manufactured to rigid specifications, tailored for best results with specific alloys. For example, ALL-STATE's S-200 silver brazing flux affords complete protection to heated base metal to 1800° F., insuring excellent capillary action and easy flowing of silver alloy. Melts at 600° F. Equal care is built into other fluxes made by ALL-STATE to assure oxide-free bonding of all metals at low temperatures.

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Bateman Bantam with punch....$575.00
Shear only $495.00
Shipping wt. 750 lbs.

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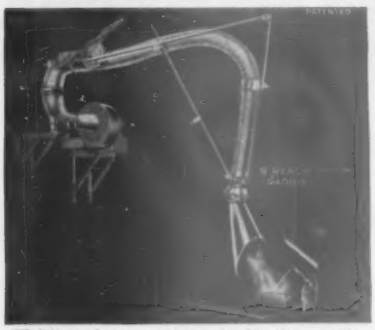

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Fuse-Well
CAST IRON WELDING RODS OR ELECTRODES

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FUSE-WELL No. 11, *Square*—Gray Cast Iron Welding Rod for Acetylene use in filling or building up new or worn castings producing machineable welds.

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Gas welding

JEFFERSON'S GAS WELDING MANUAL, 2ND EDITION. By T. B. Jefferson. Published by Associated Business Counselors, Skokie, Ill., 1959. Paper, 5 by 7½ in., 128 pages. Price, $2.00.

Jefferson's Gas Welding Manual was originally written as an advanced text on gas welding, but has been rewritten so it can be used as a basic gas welding training text.

A new first chapter covers phases specially designed to acquaint the beginning student with the equipment used in gas welding and cutting. The jiffy welding guides, which proved so popular in the original volume by presenting concise and precise basic data needed for the oxyacetylene welding of any weldable metal, are again included.

There is also a chart which helps you select the proper means of joining dissimilar metals by the oxyacetylene process. Manual flame cutting is also covered by a series of guides which show the best flame cutting techniques for the most efficient severing of metal.

To help the hobby weldor, there has been added a chapter which offers suggestions in this field. In addition, there are also practical welding suggestions for repair and maintenance activities around the farm and home. These features, coupled with numerous tables, charts, and illustrations make this a most complete and compact book on the oxyacetylene welding processes.

Pressure vessels

THE UNFIRED PRESSURE VESSEL CODE SIMPLIFIED. By Robert Chuse. Published by Robert Chuse, Leonia, N. J., 1958. Paper, 8½ by 11 in., 48 pages. Price, $6.50.

The Unfired Pressure Vessel Code Simplified is a condensed analysis of the *ASME Unfired Pressure Vessel Code*. Written in simple terms, this compact book brings to the reader useful information gained by the author in 22 years of approving ASME code design.

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code easy to use, but it can save valuable time and material. There are simplified charts for internal and external pressure, shell thicknesses, flanged and dishhead thickness, flathead thickness, flat cover plate thickness and openings and reinforcements.

This edition, which is an enlargement over previous ones, also includes new charts on external pressures on heads, stampings, head and shell volumes, welding qualifications and new information on magnetic particle and penetrating oil tests. Plate identification, non-identified materials and welded repair procedure are discussed.

Also included is information on Canadian pressure vessel requirements as well as code symbols and certification procedures for the ASME codes.

Arc welding

ARC WELDING TRAINING MANUAL. Published by the American Welding Society, New York City, 1959. Price, $3.00.

Designed for weldors and instructors of manual metal-arc welding, *Arc Welding Training Manual* includes chapters on welding processes and recommended safety practices, metal-arc processes, accessories, exercises in arc welding, arc welding equipment, identification of metals, and metals and their structure. Profusely illustrated, the manual contains 337 line drawings, halftones and tables.

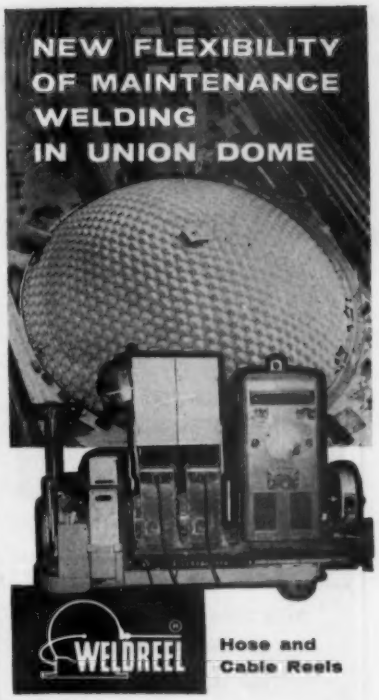
Fifty pages are devoted to arc welding exercises. Step by step illustrations show how each operation is performed, and each exercise details the material, electrode, amperage, voltage, polarity and purpose of the particular exercise.

Soldering

SOLDERING MANUAL. Published by the American Welding Society, New York City, 1959. Price, $5.00.

This first manual on soldering contains 81 illustrations and 34 tables, completely covering all phases of soldering, combining the theoretical with the practical.

The 21 chapters deal with: principles of soldering; solders; fluxes; joint design; precleaning and surface preparation; equipment, processes and procedures; flux residue treatment; inspection and testing; copper and copper alloys; steel, coated steels; stainless steels; nickel and high-nickel alloys; lead and lead alloys; aluminum and aluminum al-



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Molybdenum brazing

WELDING AND BRAZING OF MOLYBDENUM. By N. E. Weare and R. E. Monroe, Defense Metals Information Center, Battelle Memorial Institute for Office of Director of Defense, Research and Engineering, Dept. of Defense. Price, $1.25. (Order PB 151063 from OTS, U. S. Dept. of Commerce, Washington 25, D. C.)

This report identifies the best methods, taken from published literature, for welding molybdenum to itself. It also provides guidelines for producing the most useful molybdenum joints.

Metallurgical considerations involved in joining the metal are discussed, as well as cleaning and testing techniques. Joining processes examined include fusion, resistance and solid-state welding, and brazing.

Welding aluminum

AIRCOMATIC AND HELIWELDING OF ALUMINUM. Published by Air Reduction Sales Co., 150 E. 42nd St., New York 17, N. Y., 1959. Spiral bound book, 120 pages.

The subject is covered comprehensively, from a brief historical note on the earliest uses of the Mig and Tig processes for welding aluminum, to the highly specialized fabrications of today.

Topics discussed include: weldability of aluminum and its alloys, definitions of the two welding processes, proper process selection for certain jobs, descriptions of manual and automatic equipment, welding power supplies, and safety practices. Book contains 100 photographs, charts and diagrams. When writing the company for copy, specify form ADI 1258.

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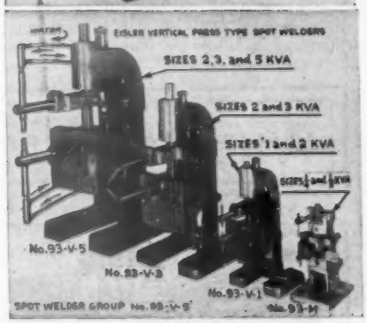

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(Taken from the WELDING ENGINEER of October, 1929)

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R. D. Thomas and Co. of Philadelphia and New York announce that they are now distributors for the new Arcos electrodes. These electrodes have been developed in Belgium.

—30 YEARS AGO—

Alexander F. Jenkins, president and treasurer of Alexander Milburn Co., Baltimore, is sailing for England this month aboard the "Leviathan" for an indefinite visit.

—30 YEARS AGO—

Col. O. E. Engler, president of The Balbach Co., Omaha, after devoting two weeks in active service of The United States Army, decided that this, together with his activities as president of the Gas Products Association, was sufficient justification for a vacation at Colorado Springs.

—30 YEARS AGO—

D. J. Will, vice president of Stuart Oxygen Co., San Francisco, distributors of Rego apparatus, was a visitor at The Bastian-Blessing factory the latter part of September.

—30 YEARS AGO—

Jack Kelly and Henry Booth of Shawinigan Products Corp., New York, were in Chicago for the weekend of Oct. 12, following their visit to the International Petroleum Exposition at Tulsa.

—30 YEARS AGO—

E. B. Whitmore, president of Whitmore Oxygen Co., Salt Lake City, producers of oxygen and hydrogen and distributors of National Carbide and Meco welding apparatus, recently visited Chicago, Washington and New York.

—30 YEARS AGO—

T. McLean Jasper, director of research for A. O. Smith Corp., Milwaukee, in the "Iron Age" magazine of Sept. 26 discussed the effect of tests conducted by his firm on steel plate and welds in pressure vessels.

—30 YEARS AGO—

At the recent annual meeting of the National Safety Council, held at Stevens Hotel, Chicago, J. I. Banash, consulting engineer of the International Acetylene Association, was elected treasurer of the Council for the coming year.

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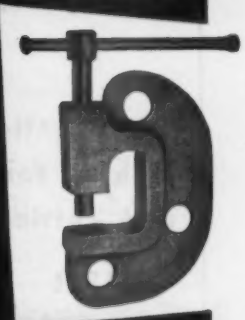

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75. PIPELINE WELDER—M. J. Crose Mfg. Co. Automatic double-jointing welder's features, specifications and representative case histories are covered in flyer.

76. ARC WELDER—Lincoln Electric Co. Features, standard and optional, and specifications of TM model AC and AC/DC Idealarc welders are detailed in brochure 4607.1.

77. HIGH PRODUCTION WELDERS—National Electric Welding Machines Co. Examples of specially engineered welders designed for high production are shown in Vol. 11, No. 6 of "Welding News."

78. BLAST-CLEANING BLADES—Wheelabrator Corp. Bulletin gives price information and lists sizes of tungsten carbide blades for company's airless abrasive blast-cleaning equipment.

79. RADIATION WARNING DEVICE—Curtiss Wright Corp. Model 860 X-ray, gamma ray warning unit, with flashing red light, is described on catalog sheet.

80. SHAPE CUTTING UNIT—National Cylinder Gas Div. Type R flame shape-cutting unit, plus section on electronic line tracer, are topics of pamphlet N-102.

81. ARC WELDING—Linde Co. Results of field testing and evaluation of magnetic-flux gas-shielded arc welding are topics of booklet F-1235.

82. FUSION SEAMERS—Pandjiris Weldment Co. Twenty-page catalog No. 5158 describes fusion seamers of both the internal and external types, and their applications.

83. NICKEL PLATING—International Nickel Co. Booklet gives, in a nontechnical way, "Practical Answers to 40 Practical Questions about Nickel Plating," pertaining to all phases of plating.

84. WELDING CABLE—Belden Mfg. Co. Catalog No. 8233 lists complete information on all types of welding cable for every application.

85. BEAM CUTTING MACHINE—Alamo Iron Works. Beams cutting and beveling machine Model 865, which will square and bevel I beams of from 36 to 48-in., is described and pictured in Bulletin 865-595.

86. GROUND CONNECTOR—Erico Products Inc. One Shot ceramic ground connection mold for cable to ground rod is covered by catalog sheet.

87. SAFETY GLASSES—Bausch & Lomb. Brochure gives complete details on new metal-frame safety glasses, Model M-70.

88. AIR-HYDRAULIC CYLINDER—The Electro-Mechano Co. Air-hydraulic unit, which can be set up in any combination of fast and slow feed throughout stroke, is detailed on catalog sheet.

89. OIL-BURNING SALAMANDER—Nugent Corp. Smokeless oil-burning salamander featuring heavy-duty construction for longer life is described on flyer.

90. CENTERLESS GRINDERS — Norton Co. Complete information on line of centerless grinders is given on Catalog 1328.

91. RESISTANCE WELDING—The Federal Machine and Welder Co. Working knowledge of basic principles of resistance welding, including information on various calculations, is given on Bulletin PP-54.

92. RECTIFIERS AND DIODES—International Rectifier Corp. Ratings, electrical characteristics and description data on silicon and selenium rectifiers and diodes are given in short form catalog.

93. HARD SURFACING—The McKay Co. Section 1 of Hard Surfacing Manual gives data on hard surfacing applications, electrodes and various related wires.

94. CRYOGENERATORS—North American Philips Co., Inc. Folder titled "Norelco Cryogenerators—For Gas Liquefaction Systems" gives engineering information of four models, and describes operating principles of the cryogenerator.

95. ULTRASONIC TESTING—Almar-York Co., Inc. Model 101 Coinda-Scope for ultrasonic testing of bonded structures is pictured and described on Form 101-C.

96. METAL CUTTING MACHINES—American Pullmax Co., Inc. Descriptive literature tells about metal cutting machines Models P-5 and P-7, for cutting up to 7/32 and 9/32-in. mild steel respectively.

97. ALUMINUM—Reynolds Metals Co. Brochure titled "Reynolds Aluminum Mill Products" gives complete specifications for many alloys and forms of aluminum available for industrial use.

98. CHAIN LINK FENCE—American Chain & Cable Co., Inc. Styles and features of chain link fence, with aluminum coating for minimum maintenance, are detailed in folder BH-16B.

99. CENTER GRINDING WHEELS—Simonds Abrasive Co. Flyer EAS-244 describes depressed center grinding wheels for weld grinding and general uses.

100. TOOL STANDARDS—Jergens Tool Specialty Co. New catalog is said to be complete source for data on all "standards" for tool, die, jig and fixture design and applications.

101. SELENIUM RECTIFIERS—Syntron Co. Ten page illustrated catalog gives data and specifications on selenium rectifiers.

102. SPOTWELD FASTENERS—The Ohio Nut and Bolt Co. Bulletin 595 lists dimensional information on spotweld fasteners and gives typical applications.

103. INDUSTRIAL VALVES—Barksdale Valves—Valves for use with water, oil and air, as well as typical flow patterns, port sizes and ordering data, are itemized in Catalog 59-60.

104. REPAIR PARTS—La Salle Steel Co. Solutions to maintenance and repair part problems are given in "How to Make Your Own Machine and Repair Parts Quicker and Easier."

105. ALUMINUM CASTING ALLOY—Navan Products, Inc. Design specifications, mechanical properties and casting technique of company's TENS-50 high strength aluminum casting alloy are subject of brochure.

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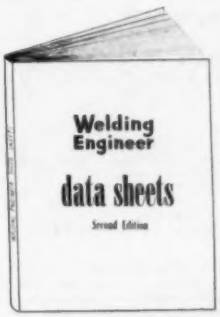

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Literature offered in ads

150. Acro Welder Mfg. Co.—Write for further information on welding machinery, engineered and manufactured to order.

151. Air Reduction Sales Co.—Further information on the new multiple-torch shape cutting machine.

152. Alloy Rods Co.—"Handbook for Welding Low Alloy High Tensile Steels" is available.

153. All-State Welding Alloys Co.—Instruction Manual available and information on fluxes custom coated on your own rods.

154. Aluminum Co. of America—Further information and films on a loan basis, on aluminum welding and brazing processes.

155. Alva Allen Industries—Write for catalog giving complete information, specifications and prices on Allen's heavy duty punch presses.

156. American Optical Co.—Further information on the new AO "Coverglas" goggle available.

157. Anti-Borax Compound Co.—Descriptive circular and free sample of brazing flux available.

158. Atlas Welding Accessories Inc.—Write for form WCT-250, describing the "Dual Tools" and other weld cleaning tools.

159. Bateman Foundry & Machine—Complete information on the "Bantam Iron Worker" available and name and address of your nearest distributor.

160. Bay State Abrasive Products Co.—For ideas in grinding problems send for the name of the "Bay State" distributor nearest you.

161. Becker Brothers Carbon Co.—Catalog on "Keen-Cut" electrodes, carbon rods and plates, welding paste, graphite cores and chills and graphite powder is available.

162. Bernard Welding Equipment Co.—Further information on Bernard water coolers available.

163. S. Blickman Inc.—Write for technical bulletins on various types of welding enclosures.

164. Bren Weld Corp.—Further information available on the Bren Weld arc spot weld gun.

165. Brown Boveri Corp.—Write for complete details on induction heating equipment for stress relieving, and cost estimate questionnaire.

166. Cam-Lok Div.—Bulletin No. 301 on the complete line of Receptacles and Plugs is available.

167. Carol Cable Co.—Further information available on Carol's "Dynapower" welding cable.

168. Chicago Boiler Co.—Complete details on the "Red Head" lifting clamps available.

169. Chicago Hardware Foundry Co.—Information on "Fuse-Well" cast-iron welding rods and electrodes available.

170. Clements Mfg. Co.—Bulletins on "Clements Cadillac Model K Blowtorch."

171. Columbia Electric Mfg. Co.—Write for illustrated catalog on "Tong Test AC-DC Ammeter."

172. Contour Sales Co.—Data available on "Curv-O-Mark" pipe-layout tools, for marking pipes and structural angle cuts of any type.

173. Coyne Cylinder Company—Information on Coyne's "92" acetylene cylinder available.

174. Curtiss-Wright Corp.—Write for further information on radiographic inspection equipment.

175. Dockson Corp.—Complete catalog on Dockson's welding and cutting equipment available, also name and address of your nearest distributor.

176. Duro Engineering Co.—Write for further information on the Duro "Standard" holder and the "Durogon" tong-type holder.

177. Eastman Kodak Co.—Information on industrial x-ray films manufactured by Eastman Kodak.

178. Eisler Engineering Co., Inc.—Catalog 93-57 on spot and wire butt welders and the vertical type press welder.

179. Engwald Corp.—Catalog WE-10 available on welding fume exhausters.

180. Eutectic Welding Alloys Corp.—Further information available on Eutectic "Low Temperature Welding Alloys" and Fluxes.

181. General Cable Corp.—Information on welding cables, copper or aluminum conductors, rubber and neoprene or super service jackets.

182. H & M Pipe Beveling Machine Co.—Write for up-to-date catalog sheets on the complete H & M line.

183. Harnischfeger Corp.—Write for a copy of "What you should know about welding positioners."

184. Harris Calorific Co.—Information on the Harris universal pressure welding torch No. 43 and the No. 49 cutting attachment available.

185. Hobart Brothers Co.—Send for the Hobart arc welders catalog featuring the new "Mainliner" welder and other welding machines manufactured by Hobart.

186. Hobart Brothers Co.—Further information available on the new Hobart 413 electrode.

187. Jackson Products—Write for further information on Jackson's new electrode holder with "Sealed Tight" cable connections.

188. Leach & Garner Co.—Technical data Sheet No. 501 available on silver brazing alloys.

189. Lenco, Inc.—Write for further information on "Threaded Power Connection" of Hi-Amp electrode holders, cable attachments and ground clamps.

190. Lincoln Electric Co.—Further information on Lincoln's "Idealarc" welder is available and other arc welding equipment manufactured by Lincoln.

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USE THIS CARD for Literature, Catalogs, and Bulletins shown on preceding pages and for those featured in this month's ads as listed opposite and on following page

Also information about

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191. Linde Co.—Write for further information on Linde's "Mighty Midget" welder.

192. Linde Co.—Folder F-1313 on the "Purox E Cutting Torch" is available.

193. Lummis Mfg. Co.—Write for information on the "Key-Bak" key reel for your weldors.

194. Maitlen & Benson Inc.—Information on "Wypo" cutting and welding tip cleaners.

195. P. R. Mallory & Co., Inc.—Wall chart available, "Do's and Don'ts for Resistance Welding."

196. A. Mamaux & Son—Write for information on welding screens manufactured by Mamaux.

197. Manhattan Rubber Div.—Further information available on the new "Safety-Back Flared Cup Wheel" for metal removing.

198. The Merit Co.—Additional information on the "Merit Might Midget" portable spot welder.

199. Merrill Brothers—Write for further information on Merrill's material handling devices.

200. Messer Cutting Machines, Inc.—Write for full information on oxygen cutting equipment.

201. Metal & Thermit Corp.—Write for literature on M & T "Murex" electrodes and the complete line of welding machines manufactured by Metal & Thermit.

202. Metalloy Products Co.—Testing sample of "Galvalloy" available for your galvanizing job.

203. Miller Electric Mfg. Co., Inc.—Complete specifications on the "Big Twin" and "Little Twin" welders will be sent on request.

204. National Carbide Co.—Write for additional information on calcium carbide and name of your nearest distributor.

205. National Welding Equipment Co.—Send for illustrated folder #17 on the combination welding and flame cutting outfit called the "Five Star Pak."

206. Norton Co.—Further information on Norton's reinforced wheels for grinding, cutting or slotting jobs.

207. Page Steel & Wire Div.—Folder containing information on submerged arc and inert gas automatic welding wire, and chart is available.

208. Phelps Dodge Copper Products Corp.—Information on Phelps Dodge "Habirprene" arc welding cable is available.

209. Picker X-Ray Corp.—Write for further information on the Picker "Ferroscope" for magnetic particle inspection.

210. J. M. Ragle Industries—Additional data on the "Commando" round soapstone holder and other "Commando" products is available.

211. Riegel Textile Corp.—Information available on Riegel gloves for weldors.

212. Ronan & Kunzl Inc.—Write for information on storage and transport containers.

213. Ruemelin Mfg. Co.—Detailed information on the Ruemelin fume collector is available.

214. Shawinigan Products Corp.—Information on calcium carbide available and name of your nearest distributor.

215. Shoot-A-Lite Corp. — Literature on "Safety Gas Liter" for welding and cutting torches.

216. Stoody Co.—Further information on Stoody's "Tube Borium" for hardfacing.

217. Stulz-Sickles Co.—Write for additional information on "Manganal" semi-automatic wire and name of your nearest distributor.

218. Tec Torch Co., Inc.—Further information on the new Tec "Pencil" torch with off-set gas nozzle and off-set chuck which enables you to weld in normally inaccessible areas.

219. Tempil Corp.—Write for further information on Tempilstiks, available in 80 different temperature ratings.

220. Tennessee Fabricating Co.—New catalog on over 400 casting designs, tubing, welding rods and machine tools and supplies is available.

221. Thermacote Co.—Write for further information on "Thermo Sta-Kleer" cover lens and free sample.

222. Tuffaloy Dept., Air Reduction Sales Co.—Catalog and prices on Tuffaloy spot welding tips, tip holders and adapters.

223. Tweco Products Co.—Information on Tweco ground clamps and "Twecolog" showing the complete line of Tweco accessories.

224. United Specialties Inc.—Full information on "Weldreel" hose and cable reels sent on request.

225. Vernon Tool Co., Ltd.—Write for bulletin No. P-10 on "Pantograph" pipe cutting equipment.

226. Victor Equipment Co.—Write for Hardfacing Manual, showing right rod to use and how to apply it, also dealerships available in some areas.

227. Victor Equipment Co.—Information on Victor's torches and other equipment manufactured by Victor.

228. Westinghouse Electric Co.—Write for further information on the new Silicon compact Rectifier Welder.

229. York Engineering Co. — Information available on York's "Spat-R-Pruf" compound, to eliminate spatter grinding after welding.

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